



# **Resource Allocation: Weighted Capitation Formula**

*Seventh Edition*



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# Resource Allocation: Weighted Capitation Formula

*Seventh Edition*

Prepared by DH Financial Planning and Allocations Division



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# Preface

The weighted capitation formula has informed recurrent revenue allocations in 2011-12 of £85 billion to Primary Care Trusts (PCTs). This is a significant proportion of public expenditure. It is therefore important that NHS finance managers, and others with an interest in the funding of the NHS, have access to an explanation of how the formula is determined and used to set PCTs' target allocations.

The seventh edition<sup>1</sup> of this publication incorporates changes to the weighted capitation formula for 2011-12 allocations. Complementing this booklet, the 2011-12 PCT Revenue Allocations Exposition Book sets out the detailed calculation of each PCT's target allocation from the weighted capitation formula, and also each PCT's actual allocation, which is informed by target allocations.

We have tried to make this booklet accessible to non-specialists, and to satisfy the needs of those requiring a fuller understanding of how the formula works. We explain some of the technical terms in the glossary. However, for full details of the modelling upon which various elements of the formula are based, we refer readers to the reports of the researchers who undertook this work. We have provided a list of Resource Allocation Research Papers (RARPs) in Appendix 2. These, and other information about allocations, including the 2011-12 PCT Revenue Allocations Exposition Book, are available at [www.dh.gov.uk/allocations](http://www.dh.gov.uk/allocations).

The White Paper, *Equity and Excellence: liberating the NHS* (CM7881) set out plans for the future arrangements for allocating NHS resources, under which the NHS Commissioning Board will be responsible for the allocation of the majority of NHS resources. How allocations are determined will be a matter for the Board. These plans are subject to Parliamentary approval.

We welcome comments on whether this booklet meets the needs of our readers. We can be contacted by email at [allocations@dh.gsi.gov.uk](mailto:allocations@dh.gsi.gov.uk).

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<sup>1</sup> Previous editions of this booklet were published in October 1994, February 1997, July 1999, March 2003, May 2005 and Dec 2008 and are available at [www.dh.gov.uk/allocations](http://www.dh.gov.uk/allocations).



# Executive summary

## Introduction

1. The Department of Health has used a weighted capitation formula since 1977-78 to determine target shares of available revenue resources between NHS areas.
2. The underlying principle of the weighted capitation formula is to distribute resources based on the relative need of each area for health services. For this reason, it is also sometimes referred to as a fair shares formula. The aim of the current formula is to enable Primary Care Trusts (PCTs) to commission similar levels of health services for populations with similar need, with the further objective since 1999 of helping to reduce avoidable health inequalities.
3. The weighted capitation formula has informed recurrent revenue allocations of £85 billion to PCTs in 2011-12. Under the formula, PCTs' target shares of the available resources are based on their share of the England population, with these shares adjusted, or weighted, to account for their population's needs for health services relative to that of other PCTs.
4. Four elements are used to set each PCT's *actual* allocations:
  - (a) target allocations at the start of the year - determined by the weighted capitation formula. The formula sets each PCT's target share of available resources based on PCT populations adjusted for
    - (i) their age distribution (PCTs with more elderly populations have higher target allocations, all else being equal)
    - (ii) additional need over and above that relating to age (PCTs with less healthy populations and higher levels of deprivation have higher allocations, all else being equal)
    - (iii) unavoidable geographical differences in the cost of providing services - the Market Forces Factor (MFF) (PCTs in high cost areas have higher allocations, all else being equal)
  - (b) recurrent baselines at the start of the year – which are the previous year's actual allocations adjusted, for example, for any newly devolved central budgets and transfers of responsibilities and their associated budgets between PCTs

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- (c) distances from targets (DFTs) – which are the differences between (a) and (b) above. If (a) is greater than (b), a PCT is said to be under target. If (a) is smaller than (b), a PCT is said to be over target
  - (d) pace of change policy which determines actual allocations. PCTs do not receive their target allocations immediately but are moved towards their targets over a number of years. Pace of change policy sets the differential growth in allocations which PCTs receive over step (b). This typically entails a minimum, or floor, level of growth which all PCTs receive to deliver on national and local priorities, plus higher growth for under target PCTs. The PCTs furthest under target receive the highest growth to move them closer to their target allocations. Pace of change policy is decided by Ministers for each allocations round.
5. PCTs have been given control over an increasing proportion of the NHS revenue budget over time and this is reflected in the formula which has three components:
    - (a) hospital and community health services (HCHS) – by far the largest component, accounting for 79% of the formula
    - (b) prescribing (the cost of drugs prescribed by GPs)
    - (c) primary medical services.
  6. Each of the components has adjustments for age related need, additional need over and above that related to age and, with the exception of prescribing (due to lack of variation in the price of drugs), unavoidable costs. While these adjustments necessarily differ in detail for each component, they are based on the same common principles. In addition, within HCHS there are separate age and additional need adjustments for acute services, maternity and mental health, and a separate adjustment for HIV/AIDS.
  7. The Advisory Committee on Resource Allocation (ACRA) advises the Secretary of State for Health on the weighted capitation formula. ACRA is an independent expert body whose membership includes individuals with a wide range of expertise from within, and outside, the NHS. ACRA is supported by a Technical Advisory Group (TAG).
  8. ACRA's most recent recommendations, covering the main elements of the formula - the population base, the need adjustments and the MFF - are published in a letter to the Secretary of State (September 2010)<sup>2</sup>.
  9. The weighted capitation formula and the seventh edition of this booklet have been fully updated to incorporate the outcome of ACRA's recommendations. As with

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<sup>2</sup> This, and other information about resource allocation, is available at [www.dh.gov.uk/allocations](http://www.dh.gov.uk/allocations).

earlier editions, the focus of the booklet is on the weighted capitation formula. Further information about actual allocations, recurrent baselines, DFTs, and pace of change policies is available in the PCT Revenue Allocations Exposition Books, as is the detailed calculation of each PCT's target allocation, available at [www.dh.gov.uk/allocations](http://www.dh.gov.uk/allocations).

## Population

10. Health services are for people and the starting point and primary determinant of weighted capitation targets must therefore be the size of each PCT's population.
11. Each PCT's responsible population consists of:
  - (a) the number of people permanently registered with the PCT's GP practices (that is, the GP practices for which the PCT holds the contract). This means that those patients permanently registered with a GP practice in one PCT's area, but who are resident in a neighbouring PCT's area, remain the responsibility of the former PCT
  - (b) the number of residents within the geographical boundaries of each PCT who are not permanently registered with any GP practice. For allocation purposes, this group is restricted to those for whom accurate data are available for all PCTs, and also to those for whom the PCT has formally been defined as the responsible commissioner of health services to be funded by PCT revenue allocations. In practice, this group covers prisoners, armed forces and asylum seekers.
12. Nationally, the total number of GP registrations exceeds the population as estimated by the Office for National Statistics (ONS). GP registrations for allocation purposes are scaled to match ONS's population projections at the local level, while maintaining the pattern of 'cross-border' flows of patients resident in one PCT who are registered with the GP practice of a neighbouring PCT. For 2011-12 target allocations, ONS population projections for 2011 have been used. These 'scaled' populations are referred to as constrained populations.

## Need

13. Population is the starting point but the make-up of the population is also critical. People do not have identical needs for health services. A key difference is that need varies according to gender and age, and in particular, the very young and elderly, whose populations are not evenly distributed across the country, tend to make more use of health services than the rest of the population. The weighted capitation formula therefore takes into account the different age structures of local populations. The age adjustment is based on the national average spend on health services by age group.

## Resource Allocation: Weighted Capitation Formula

14. Even when differences due to age are accounted for, populations with the same age profiles display different levels of need. An additional adjustment to reflect the relative need for health services over and above that accounted for by age is necessary.
15. Observing additional need directly has not proved possible to date. Instead, statistical modelling by academics has examined across small geographical areas the relationship between the utilisation of health services on the one hand, and the socio-economic characteristics, population health status and measures of the availability of health services for those small areas on the other hand. These models have been used to decide which factors to include in the formula as indicators of additional need, and with what relative weights.
16. The main changes to the need components of the overall weighted capitation formula for 2011-12 allocations are:
  - (a) a new, improved formula for mental health, based on a recently available new data source, which for the first time covers community care as well as hospital based care
  - (b) an updated prescribing formula, using more recently available data.
17. The need formulae are based on the utilisation of health care services, and therefore capture the NHS's response to current patterns of health inequality. ACRA felt that they did not adequately address the objective of contributing to the reduction in avoidable health inequalities. In 2008, ACRA therefore recommended a separate component in the formula to meet this objective, which was included in the weighted capitation formula used for 2009-10 and 2010-11 target allocations. This uses disability free life expectancy (DFLE), which is the number of years from birth a person is expected to live which are free from limiting long-term illness and disability. It is applied by comparing every PCT's DFLE to a benchmark figure of 70 years.
18. The same DFLE formula is included in the weighted capitation formula used to determine 2011-12 target allocations. It is not currently possible on a technical basis to determine the weight for this DFLE formula relative to the utilisation based need formulae. In 2010, as in 2008 for the previous round of allocations, ACRA was therefore not able to recommend a weight for the DFLE formula, and Ministers decided to give it a weight of 10% for 2011-12 allocations.

## Unavoidable costs

19. The weighted capitation formula has to take account of the fact that the cost of commissioning or providing healthcare services is not the same in every part of the country due to the impact of market forces on local costs. The MFF is included



in the weighted capitation formula to allow for these unavoidable geographical variations in costs. Under Payment by Results (PbR), a MFF is also paid to NHS providers.

20. The HCHS MFF is built up from separate indices for non-medical staff, medical and dental staff, buildings and land.
21. The majority of HCHS spending is on staff. The MFF for non-medical staff is based on the variation across the country in wages in the private sector.
22. Although wages in the NHS are determined through national pay structures, there is clear evidence for non-medical staff that indirect staff costs across the country vary in line with the going local labour market wage rate in the private sector. If wages in the NHS in a given area are below the going rate set in the private sector, this leads to higher indirect costs in the form of recruitment and retention difficulties, increased reliance on bank and agency staff, and lower productivity.
23. To calculate the non-medical staff MFF, statistical modelling of hourly pay in the private sector is undertaken in order to control for the influence on private sector earnings of age, gender, industry and occupation of each area's workforce, and therefore isolate the independent effect of geographical work area on earnings. This independent geographical effect is the basis of the MFF adjustment.
24. Some of the resulting estimated private sector pay rates differ markedly, and unrealistically, between neighbouring PCTs' areas. These "cliff edges" are unlikely to represent accurately the true underlying differences in pay, not least near the borders of PCT areas, but instead are likely to reflect to some extent the effect of, unavoidably, using a geography of administrative boundaries to estimate private sector pay rates which cut across local labour markets. The technique of smoothing, a form of averaging, is used to reduce these cliff edges.
25. Smoothing is undertaken in two stages. The first stage smoothes the estimated pay rates for PCT areas: for a given PCT, the smoothed MFF is the weighted average of the estimated pay rates for all PCTs, with the pay rate of the PCT in question being given the largest weight, and the weights of the other PCTs' declining the further the geographical distance from the PCT in question.
26. At one time, NHS providers were assigned the same MFF as the PCT where they were located. Under this approach, there are still likely to be cliff edges between neighbouring providers which operate in the same labour market but are located in different PCT areas. A second stage of smoothing, termed interpolation, was therefore introduced, carried out at NHS provider site level, to reduce further the impact of cliff edges between NHS organisations. The purpose of this stage is to take account of where the provider is located within a PCT's area, since the MFF for the PCT's area as a whole is unlikely to represent the provider's local labour

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market. This second stage uses the weighted average of first stage smoothed PCT MFFs, but with the weights being the distance from the NHS providers' actual sites. The weights also declined with distance from the provider. This gives the MFF value for each provider.

27. A MFF based on pay rates in the private sector is not applied to expenditure on medical and dental staff because the evidence shows their indirect employment costs do not vary across the country as they do for other NHS staff. Instead, there is a separate index for medical and dental staff based on the NHS London pay weighting.
28. The buildings and land components of the MFF are based on an index of tender prices for buildings provided by the Building Cost Information Service (BCIS), and the land values per hectare of NHS organisations.
29. For 2011-12, the non-medical staff MFF has been updated by using the latest data on earnings (for 2007-09). The medical and dental, land and building components have also been updated for more recently available data.
30. Each PCT's final MFF for the HCHS component of the formula is an average of the MFF values of the providers from which it commissions for acute activity, weighted according to the value of services commissioned from each provider, and the PCTs' own geographical area based MFFs for community programmes and maternity services provided in many sites across its area.
31. The primary medical services component of the formula has separate MFFs for practice staff, buildings and land, and a MFF for GP pay which is intended to compensate deprived PCTs which face greater GP recruitment and retention difficulties. The prescribing component does not have an MFF as the cost of drugs does not vary across the country.
32. The emergency ambulance cost adjustment (EACA) within the HCHS component reflects the unavoidable cost variations of delivering emergency ambulance services in different areas.

## Combining the formula adjustments

33. A separate index is generated for each of the age, additional need and MFF adjustments (though for general and acute, age and additional need are combined in a single index, and the MFF is not applicable for prescribing costs). Each index is a relative index: each PCT is given an index value on the adjustment relative to the national average which is given a value of one. Index values above one show estimated need or cost above the national average, and index values below one show estimated need or costs below the national average. The weighted population for each PCT is calculated by simultaneously multiplying the PCT's

population by these indices as follows:

$$\text{Weighted Population} = \text{Population} \times \text{Age Index} \times \text{Additional Need Index} \times \text{MFF Index}$$

34. Weighted populations are calculated in this way separately for the HCFS, prescribing and primary medical services components, and combined using the share of each component in national expenditure to create a single weighted population for each PCT. Each PCT's monetary target share of the total resources available is the same as its weighted population as a share of the total England population.



# Section 1: Introduction

## ELEMENTS OF RESOURCE ALLOCATION

1. The weighted capitation formula is used to determine PCTs' target shares of available recurrent revenue resources, with the aim of enabling them to commission similar levels of health services for populations with similar healthcare need, and to help reduce avoidable health inequalities.
2. The following four elements are used to set PCTs' *actual* allocations:
  - (a) target allocations at the start of the year - determined by the weighted capitation formula. The formula sets each PCT's target share of available resources based on PCT populations adjusted for
    - (i) their age distribution
    - (ii) additional need over and above that relating to age
    - (iii) unavoidable geographical variations in the cost of providing services - the Market Forces Factor (MFF)
  - (b) recurrent baselines at the start of the year – which are the previous year's actual allocations adjusted, for example, for any newly devolved central budgets and transfers of responsibilities and their associated budgets between PCTs
  - (c) distances from target (DFT) - which are the differences between (a) and (b) above. If (a) is greater than (b), a PCT is said to be under target. If (a) is smaller than (b), a PCT is said to be over target
  - (d) pace of change policy which sets actual allocations. PCTs do not receive their new target allocations immediately, but are moved towards their targets over a number of years. Pace of change policy sets the differential growth in allocations PCTs receive over step (b). This typically entails a minimum, or floor, level of growth which all PCTs receive to deliver on national and local priorities, plus higher growth for under target PCTs. The PCTs furthest under target receive the highest growth to move them closer to their target allocations. Pace of change policy is decided by Ministers for each allocations round.
3. The remainder of this booklet is solely concerned with the weighted capitation formula. Information about actual allocations, recurrent baselines, distances from target and pace of change policies is in the Exposition Books, as is the detailed

## Resource Allocation: Weighted Capitation Formula

calculation of each PCT's target allocation, published for each allocations round at [www.dh.gov.uk/allocations](http://www.dh.gov.uk/allocations).

4. The White Paper, *Equity and Excellence: liberating the NHS* (CM7881) set out plans for the future arrangements for allocating NHS resources, under which the NHS Commissioning Board will be responsible for the allocation of the majority of NHS resources. How allocations are determined will be a matter for the Board. These plans are subject to Parliamentary approval.

## COMPONENTS OF THE FORMULA

5. The weighted capitation formula has three main components:
  - (a) hospital and community health services (HCHS)
  - (b) Prescribing (the cost of drugs prescribed by GPs)
  - (c) primary medical services.
6. A weighted population is produced for each of these three components for each PCT. These weighted populations are then combined into a single weighted population for each PCT, and the latter converted into monetary targets. A single distance from target is calculated for each PCT and pace of change policy is based on these single DFTs for each PCT.
7. The schematic diagram at Appendix 1 illustrates the components of the formula and their need and cost adjustments.

## DEVELOPMENTS IN THE WEIGHTED CAPITATION FORMULA

8. The remainder of this section describes the evolution of the weighted capitation formula since its introduction in 1977-78. Whilst providing useful context, readers who are most interested in the current weighted capitation formula may prefer to proceed directly to Section 2.

## RAWP

9. For the first thirty years of the NHS, resources were distributed largely on the basis of historical patterns of spending. By the early 1970s this was recognised as leading to inequities and inefficiencies. The Resource Allocation Working Party (RAWP) was set up to recommend a resource allocation system which was responsive to the differing health needs of the population across the country, and to identify and correct inequalities in the existing pattern of distribution of funding.

10. Since RAWP reported in 1976, in *Sharing Resources for Health in England Report of the Resource Allocation Working Party*<sup>3</sup> (RARP 1), there has been a clear objective for resource allocation of “to secure equal opportunity of access to healthcare for people at equal risk”.
11. RAWP recommended distributing resources across the country on the basis of the size of population, weighted according to two basic criteria:
  - (a) need - adjustments were to be made to reflect perceived differences in the need for healthcare
  - (b) cost - unavoidable geographical differences in the cost of providing services.
12. This underlying principle of weighted capitation, whereby resources are distributed between NHS areas on the basis of the size of their populations adjusted for relative need, has remained in place from 1977-78 to this day.
13. Under RAWP, need was established by acknowledging the role played by demographic characteristics. The national average hospital bed utilisation rates by age and gender groups were applied to the population, by age and gender groups, of each area. RAWP recognised that additional need for health care over and above that related to age and gender, could not be measured directly and chose Standardised Mortality Ratios (SMRs) as a proxy measure of additional need.
14. Because costs were recognised as being substantially higher in the London area than in other parts of the country, RAWP recommended that an allowance should be made in the formula. Further research was carried out into the differences between areas in the cost of providing healthcare services and a MFF was subsequently introduced in 1980-81 to reflect higher staff costs, over and above the London pay weighting.
15. RAWP revealed large disparities between the way resources had traditionally been distributed and the way they would have been allocated according to the weighted capitation formula. It was accepted that change would have to take place over time and the four elements of resource allocation policy, described in paragraph 2, were introduced.
16. At the time, the RAWP formula was used as the basis for allocations to 14 Regional Health Authorities (RHAs), and modified by RHAs to inform allocations to District Health Authorities (DHAs).

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<sup>3</sup> We have listed the major research papers on resource allocation, known as Research Allocation Research Papers (RARPs), at Appendix 2. We have also listed some of the more substantive working papers, known as Resource Allocation Working Papers, at Appendix 3, these and RARPs are available at [www.dh.gov.uk/allocations](http://www.dh.gov.uk/allocations).

### Review of RAWP

17. A review of RAWP was published in 1988 in *Review of the Resource Allocation Working Party Formula (RARP 5)*. For the first time, additional need over and above that relating to age was based on a regression analysis across small areas of the determinants of variations in hospital utilisation, adjusted for the supply of facilities accessible to small areas. A modified version of the recommended formula, using the square root of all-cause SMRs under 75 years as the measure of additional need, was introduced in 1990-91.
18. Resource allocation changed in 1990-91 as a consequence of the reforms introduced by the *National Health Service and Community Care Act 1990*. DHAs were now funded for their resident population as purchasers, whereas previously they were funded for services provided to a catchment population as providers. Targets were set for RHAs on a weighted resident population basis.

### 1995-96

19. The availability of data from the 1991 Census provided a further opportunity to review the formula. A team from the University of York was contracted to carry out the work. The research, again taking the small area utilisation approach, was reported in 1994 in *A Formula for Distributing NHS Revenues Based on Small Area Use of Hospital Beds (RARP 7)*. The most significant change was the replacement of SMR as the sole proxy for additional need with two separate need indices for acute and psychiatric inpatient services (covering 76% of HCHS), each containing various health and socio-economic variables.

### 1996-97

20. Allocations were made direct to 100 Health Authorities (HAs) from 1996-97 following the abolition of the 14 RHAs and the replacement of DHAs by the new HAs.
21. A rough sleepers adjustment was introduced.

### 1997-98

22. In April 1995 a national standing Resource Allocation Group (RAG) was set up with the specific aim of looking at the future of resource allocation within the context of a primary care led NHS. As part of their work programme, new needs indices for community health services were introduced, which meant that 100% of HCHS was now weighted for need. A new staff MFF was also introduced, based on work commissioned from the University of Warwick and published in *Labour Market Forces and NHS Provider Costs Final Report (RARP 12)*.



## 1998-99

23. An emergency ambulance cost adjustment (EACA) was introduced to reflect the unavoidable cost variations of delivering emergency ambulance services in different areas.

## 1999-00

24. The Advisory Committee on Resource Allocation (ACRA) was established in September 1997 as the successor body to RAG. ACRA advises the Secretary of State for Health on the distribution of resources across primary and secondary care to ensure that these fully reflect local population need and operate as fairly as possible. ACRA is an independent expert body whose membership includes individuals with a wide range of expertise from within and outside the NHS. A Technical Advisory Group (TAG) provides technical support to ACRA.
25. ACRA's work programme for 1999-00 was dominated by *The new NHS White Paper* (1998) which introduced three main changes for resource allocation:
- (a) the creation of Primary Care Group (PCGs) as groups of GP practices with responsibility for the healthcare of their populations. Since 1999-00, allocations have been made on the basis of the constrained population - patients registered with GP practices and unregistered patients resident in the area, rather than the resident population
  - (b) HAs and PCGs were to have unified allocations covering HCHS, General Medical Services Cash Limited (GMSCL<sup>4</sup>) and prescribing. Before 1999-00, GMSCL and prescribing were separate allocations
  - (c) a national formula to set fair shares for PCGs. HAs were to allocate resources to their PCGs using the same formula (with the exception of the MFF) which had been used to allocate resources to them.
26. Other changes in 1999-00 were:
- (a) a revised additional need adjustment in the prescribing component
  - (b) the introduction of an English Language Difficulty Adjustment (ELDA) for the extra costs of interpretation, advocacy and translation services.
27. In November 1998 Ministers announced a wide ranging review of the formula suitable for *The new NHS*. A new objective for the new formula was set from 1999: "to contribute to the reduction in avoidable health inequalities". Other than routine data changes, the formula was frozen during the period of the review.

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<sup>4</sup> GMSCL covered payments to GPs for practice staff, premises and computer costs.

## Resource Allocation: Weighted Capitation Formula

### 2001-02

28. While the longer term work on the review took place, an interim health inequalities adjustment (HIA) was introduced to tackle health inequalities. The HIA was based on years of life lost (YLL).

### 2002-03

29. In 2002-03:
- (a) a new General Medical Services Non-Cash Limited (GMSNCL)<sup>5</sup> component was introduced. The *NHS Plan* had included a commitment to a single resource allocation formula covering all NHS expenditure including GMSNCL. The aim was to ensure that HAs and PCGs received, as far as possible, their fair shares of funding of primary care. GMSNCL remained non-discretionary, but unified allocations took account of GMSNCL expenditure for the first time
  - (b) the additional need adjustment in the new GMSNCL component replaced the existing adjustment in the GMSCL component
  - (c) the staff MFF was revised, increasing the number of pay zones, for which a separate MFF is calculated, from 78 to 117, and smoothing the cliff edge anomalies between HAs by an approach of averaging the wage rate for each area with its immediate neighbours
  - (d) the HIV/AIDS special allocations were mainstreamed within unified allocation.

### 2003-04 to 2005-06

30. In December 2002 allocations were for the first time made for the three forthcoming years instead of just one year ahead. These were for the years 2003-04 to 2005-06. Allocations were also made for the first time to PCTs, of which there were 303.
31. The wide ranging review initiated in 1998 had concluded and as a result new need adjustments, which took account of the new objective of contributing to the reduction in avoidable health inequalities, were introduced in the HCHS and prescribing components. These were based on research commissioned from a team led by the University of Glasgow, reported in *Allocation of Resources to English Areas (the AREA Report)* (RARP 26). For the first time the formulae also took account of unmet need, as well as the met need predicted in the utilisation approach, where certain groups within the population, eg ethnic minorities and

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<sup>5</sup> GMSNCL was, until the introduction of the new GP contract in 2004-05, a demand led central budget for the remuneration of GPs.

socio-economically deprived groups, do not receive healthcare services to the same level as that of others with similar health characteristics.

32. The researchers included two sets of determinants that were felt to address unmet need and health inequalities. They were, firstly, counterintuitive negative coefficients which were found on ethnic minority and other variables, and which were interpreted to represent underutilisation by ethnic minority and other groups. Secondly, additional morbidity measures were developed by analysing data from the Health Survey for England (HSE), which were felt to capture some aspect of illness that was not reflected in the other morbidity measures such as limiting longstanding illness, and also to ensure that the existence of the counterintuitive negative coefficients was not affected by the way morbidity was previously captured. The variables with the counterintuitive signs were included in the preferred model but excluded from the formula for target allocations, thereby giving areas with these groups an element in their target allocations for unmet need. At the same time as introducing the new formula, the interim HIA was added to PCT baselines.

### 2006-07 and 2007-08

33. For 2006-07 and 2007-08 allocations:
- (a) Office of National Statistics (ONS) subnational population projections (SNPPs) provided the population base. ONS produce population estimates annually and population projections periodically. The former are the best estimates of population for recent past years, while the projections forecast the population taking into account ageing (eg those currently aged 45 will be 48 in three years time) and assumptions based on past trends about births, deaths and migration. Population projections have generally been preferred to estimates in terms of directing funds towards where the population is expected to be in the allocation year, rather than where they were. The 2003-04 to 2005-06 allocations had been an exception, because only 2001 ONS population estimates based on the 2001 Census were available at the time the allocations were made, and not SNPPS based on the 2001 Population Census
  - (b) a primary medical services component was introduced into the formula following the devolution of this funding to PCTs as a result of the new GP contract in 2004-05, replacing the GMSCL and GMSNCL components
  - (c) the MFF was reviewed to support the implementation of Payment by Results (PbR). The main resulting change was an increase in the number of zones for which the staff MFF was calculated from 117 to 303 to match the geography of PCTs

## Resource Allocation: Weighted Capitation Formula

- (d) the rough sleepers adjustment was discontinued
- (e) a Growth Area adjustment was introduced in support of the Department for Communities and Local Government (DCLG) sustainable communities initiative.

### 2008-09 to 2010-11

34. Following the 2006-07 and 2007-08 allocations announced in 2005, ACRA began a review embracing the main elements of the formula:
  - (a) the population base
  - (b) the need adjustments
  - (c) the MFF, which has also had a direct impact on Trust incomes since the introduction of PbR.
35. ACRA did not complete this work programme in time to inform 2008-09 allocations. The formula and pace of change were frozen, and instead, all PCTs received the same uplift on their 2007-08 recurrent allocations. 2008-09 allocations were issued to the then 152 PCTs, with the uniform uplift based on a mapping to the 152 PCTs from the allocations issued in 2005 to the then 303 PCTs for 2007-08.
36. ACRA concluded their review during 2008 and reported their recommendations in *Report of the Advisory Committee on Resource Allocation* (December 2008).
37. As a result of ACRA's recommendations, 2009-10 and 2010-11 allocations:
  - (a) for the population base
    - (i) used 2008 GP registered lists constrained to 2006 based ONS SNPPs for 2009 and 2010
    - (ii) counted all prisoners in the populations of PCTs where prisons are located, rather than only those who have served sentences over six months as before
    - (iii) counted asylum seekers in PCTs using Home Office data
    - (iv) applied the national average needs weighting, rather than host PCT needs weighting to prisoners, armed forces and asylum seekers
    - (v) removed temporary GP registrations from the prescribing component
  - (b) for the need formulae

- (i) introduced new separate indices for acute and maternity in the HCHS component, based on research commissioned from a team led by Brunel University, reported in *Combining Age Related and Additional Needs (CARAN) Report* (RARP 30)
- (ii) for general and acute, calculated age related need and additional need together in a single index rather than separately as previously (based on the CARAN Report)
- (iii) introduced a new index for the prescribing component (based on the CARAN Report)
- (iv) introduced HIV/AIDS as a separate index within HCHS and removed it as a separate component
- (v) removed the ELDA
- (c) for health inequalities
  - (i) introduced a separate formula using disability free life expectancy (DFLE), applied to all components except mental health and HIV/AIDS
  - (ii) ACRA was unable to recommend on a technical basis a weight for the health inequalities formula and left this for Ministers to determine. Ministers gave a 15 per cent weight to the health inequalities formula
- (d) for the MFF, based on research commissioned from the Health Economics Research Unit (HERU) at University of Aberdeen, and reported in *Review of the Market Forces Factor Following the Introduction of Payment by Results: Exploring the General Labour Market Method* (RARP 32)
  - (i) used more recent data on earnings
  - (ii) smoothing of the PCTs' staff MFFs took account of distance from all other PCTs not just neighbouring PCTs
  - (iii) a second stage of smoothing called interpolation was introduced at provider level to take into account the distance of provider sites from the geographical centre of each PCT rather than just taking the MFF of the PCT in which they were situated
  - (iv) the staff MFF was not applied to spend on doctors and hospital dentists and a separate index for doctors and dentists was introduced based on the NHS London pay weighting
- (e) extended the growth area adjustment to include the new growth points.

2011-12

38. ACRA's recommendations for 2011-12 resulted in the following changes to the formula which otherwise remained the same as the formula for 2009-10 and 2010-11:
- (a) for the population base used 2010 GP registered lists constrained to 2008 based ONS SNPPs for 2011
  - (b) for the need formulae, based on research commissioned from a team led by the University of Manchester, reported in *Report of the Resource Allocation for Mental Health and Prescribing (RAMP) Project* (RARP 35)
    - (i) introduced new indices for mental health in the HCHS component
    - (ii) introduced an updated index for the prescribing component
  - (c) for the DFLE formula (previously health inequalities formula)
    - (i) as previously, ACRA was unable to recommend on a technical basis a weight for the DFLE formula and left this for Ministers to determine. Ministers gave a 10 per cent weight to the DFLE formula
    - (ii) the DFLE formula was applied to all components except HIV/AIDS
  - (d) the staff MFF was updated for more recent earnings data, based on research commissioned from HERU at University of Aberdeen, and reported in *The Staff Market Forces Component of the Resource Allocation Weighted Capitation Formula, New Estimates* (RARP 34a). The other components of the MFF were also updated for more recent data
  - (e) the growth area and new growth point adjustment was removed in line with the DCLG's discontinuation of this policy.

# Section 2: Population

- Population figures are the basis for calculating weighted capitation targets
- GP registrations in the Attribution Data Set (ADS) are the starting point
- These are scaled to match ONS SNPPs to produce PCT constrained populations

## Introduction

39. Health services are for people and the primary determinant of resource allocation to PCTs must be the size of the populations for which PCTs are responsible. Population is therefore the starting point for the calculation of weighted capitation targets.
40. The population base for PCTs was reviewed before 2009-10 and 2010-11 allocations by the Prescribing Support Unit (PSU) of the Information Centre for Health and Social Care, and reported in *Review of the population base for PCT revenue allocations post 2007-08* (RARP 29).
41. The definition of a PCT's population for resource allocation follows the guidance set out in *Who pays? Establishing the responsible commissioner*<sup>6</sup> which states that in general, the responsible commissioner will be determined on the basis of registration with a GP practice or, where a patient is not registered, their place of residence.
42. The PCT population for resource allocation is therefore:
  - (a) the number of people permanently registered with the PCT's GP practices (that is, the GP practices for which the PCT holds the contract). This means that those patients permanently registered with a GP practice in one PCT area, but who are resident in a neighbouring PCT's area, remain the responsibility of the former PCT
  - (b) the number of residents within the geographical boundaries of each PCT who are not permanently registered with any GP practice and for whom accurate national data are available. This group is restricted also to those for whom the PCT has formally been defined as the responsible commissioner of health services to be funded by PCT revenue allocations. In practice, this group comprises:

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<sup>6</sup> Who pays? Establishing the responsible commissioner can be found on the DH website at <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH-4069634>.

## Resource Allocation: Weighted Capitation Formula

- (i) all prisoners in PCTs where prisons are located, regardless of whether they have been sentenced or the length of sentence served
  - (ii) all UK armed forces, foreign armed forces and foreign armed forces dependants
  - (iii) all asylum seekers, after their initial applications and processing, for whom data are available.
43. The calculation of PCT constrained populations for allocations involves scaling of GP registrations to match the SNPPs produced by ONS. This scaling has two purposes. Firstly, the existence of differences between the number of GP registrations and ONS population data has been recognised for many years. These differences vary between age bands, between males and females and, most crucially, between PCTs. The scaling ensures that list variation in different parts of the country does not affect resource allocation. Secondly, registered lists are scaled to local population projections, rather than recent historical population data, as these are considered to provide the best fit in terms of directing funding towards where the population is expected to be in the forthcoming allocation year.
44. It is not possible to use ONS local population projections alone for resource allocation, because they are based on where people live, and therefore do not allow for the significant number of patients resident in one PCT area but who are registered with a GP practice for which a different PCT is responsible. In outline, the scaling involves calculating the number of GP registrations by their Local Authority District (LAD) of residence from the most recent registrations data available. This calculation is undertaken by age-gender group. These are compared by age-gender group with ONS residence based projections for LADs. The difference between these two figures for LADs, expressed as a ratio, gives the scaling factors by age-gender-LAD. The scaling factors are then applied at practice level using the latest available data on registered lists, and based on the proportion of each practice's list by age-gender group which is in each LAD. The constrained practice registered lists are then summed to give the constrained PCT registered list size. This process of constraining is explained further below, including how those populations not registered with a GP practice, group (b) above, are incorporated.
45. Two population data sources are used:
- (a) the Attribution Data Set (ADS) of GP registrations
  - (b) ONS SNPPs.



## Attribution Data Set

46. The ADS is an anonymised, non-disclosive dataset that records the home postcode of patients registered with every GP practice. It is an aggregated extract from the National Health Applications and Infrastructure Services (NHAIS) General Practice Registration systems. Each record in the extract has the structure shown in Table 1. In this illustrative example there are ten male patients aged 19-24 with postcode BE5 9XX registered with practice G11111.

**Table 1: Illustrative ADS record**

Postcode	PCT code	National practice code	Gender	Age band	Number of registrations
BE5 9XX	5MF	G11111	M	19-24	10

47. Persons recorded with a dummy practice code (for example, persons removed from a practice list) are assigned to PCTs on the basis of their home postcode. Registrations with invalid postcodes are redistributed to the overall postcode geography of their GP practice. The lists of practices affiliated to each PCT are validated with PCTs. The ADS for GP registrations as at April 2010 is used for 2011-12 PCT allocations.
48. The ADS is used in resource allocation to:
- build populations to any reference geography using patient postcode or GP practice, and in particular LAD of residence based on patients' home postcodes
  - calculate the values of the socio-economic variables in the need formulae for PCTs from the weighted average of their small area values.

## ONS subnational population projections

49. ONS make SNPPs from a base year estimate (ie the latest year for which ONS have figures for the actual population) based on ageing the population (eg those currently aged 45 will be 48 in three years time) and their assumptions for future trends in births, deaths and migrations based on recently observed levels, mainly from the past five years. The projections are produced on a consistent basis across all LADs in England.
50. The 2011-12 PCT allocations used 2008 based SNPPs<sup>7</sup> for 2011, published by ONS on 27 May 2010.

<sup>7</sup> ONS have published a methodology guide to their 2008 based subnational population projections for England at [http://www.statistics.gov.uk/downloads/theme\\_population/snpp-2008/2008\\_based\\_SNPP\\_Methodology\\_Guide.pdf](http://www.statistics.gov.uk/downloads/theme_population/snpp-2008/2008_based_SNPP_Methodology_Guide.pdf).

## Resource Allocation: Weighted Capitation Formula

### Prisoners

51. A number of groups of people who are not registered with GP practices need to be removed from the ONS SNPPs before GP registrations are constrained to match them. As PCTs are responsible for these unregistered groups, they then need to be returned to the PCT populations used for allocations. The first of these groups are prisoners.
52. For the purpose of ONS mid-year population estimates, a person is regarded as usually resident in a prison if they have been sentenced and have served six months or more of their sentence in any prison. But for PCT allocations, all prisoners regardless of length of sentence and including those untried or unsentenced are counted in the population base of PCTs where prisons are located. Data were obtained from the Justice Statistics Analytical Services in the Ministry of Justice for the prison population at June 2009 and assigned to PCTs on the basis of the prison postcode.
53. Prisoners are included in the HCHS component of the formula, but excluded from the primary care and prescribing components of the formula because for the prison population these services remain funded centrally rather than by PCTs.
54. When adjusting for need (Section 3), the national average needs weight is applied to prison populations, adjusted for age, rather than the PCT specific needs weight.

### Armed forces

55. Armed forces are typically not registered with a PCT funded GP and are therefore also subtracted from ONS SNPPs before GP registrations are constrained to match them. They are then added to the PCT populations used for allocations. They include:
  - (a) UK armed forces in the ONS mid 2008 subnational population estimates
  - (b) foreign (mainly United States) armed forces and foreign armed forces dependants according to data provided by ONS.
56. The data are provided by 354 LADs and assigned to PCTs using a matrix which estimates the proportion of each LAD's general population in each PCT. Where LADs and PCTs are not geographically coterminous, and where there were significant numbers of armed forces in an LAD, the PCTs previously confirmed that the distributions in the matrix were also appropriate for their armed forces.
57. Armed forces are included in the HCHS component of the formula but excluded from the prescribing and primary medical services components. This is because the Ministry of Defence is responsible for the primary care of UK armed forces

through the Defence Medical Services (DMS), and the US have their own arrangements for the primary care of their armed forces and dependants.

58. When adjusting for need, the national average needs weight is applied to armed forces populations, adjusted for age, rather than the PCT specific needs weight.

### Asylum seekers

59. Asylum seekers added to PCT populations for allocations for the following groups (using data from Home Office Control of Immigration: Quarterly Statistical Summary, 2nd Quarter 2009 available at <http://rds.homeoffice.gov.uk/rds/immigration-asylum-publications.html>):
- (a) in accommodation
  - (b) receiving subsistence only support
  - (c) receiving Section 4<sup>8</sup> support
  - (d) persons recorded as being detained in removal centres under Immigration Act powers (excluding Dover, Haslar and Lindholme, which are counted in the prison populations)<sup>9</sup>.
60. The data are assigned from LAD to PCT using a matrix based on ADS registrations to LAD geography and these groups are included in all components of the formula.
61. When adjusting for need, the national average needs weight is applied to asylum seekers, adjusted for age, rather than the PCT specific needs weight.

### Calculating PCT constrained populations

62. The steps taken to calculate PCT constrained populations are as follows:
- (a) construct the ADS from April 2010 extracts of the 87 NHAIS systems to group registered populations by gender, eighteen 5-year age bands (0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85+), patient postcode and GP practice

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<sup>8</sup> Support under Section 4 of the Immigration and Asylum Act 1999 is generally provided to individuals whose asylum application has been finally determined as refused, but who are destitute and temporarily prevented from leaving the United Kingdom

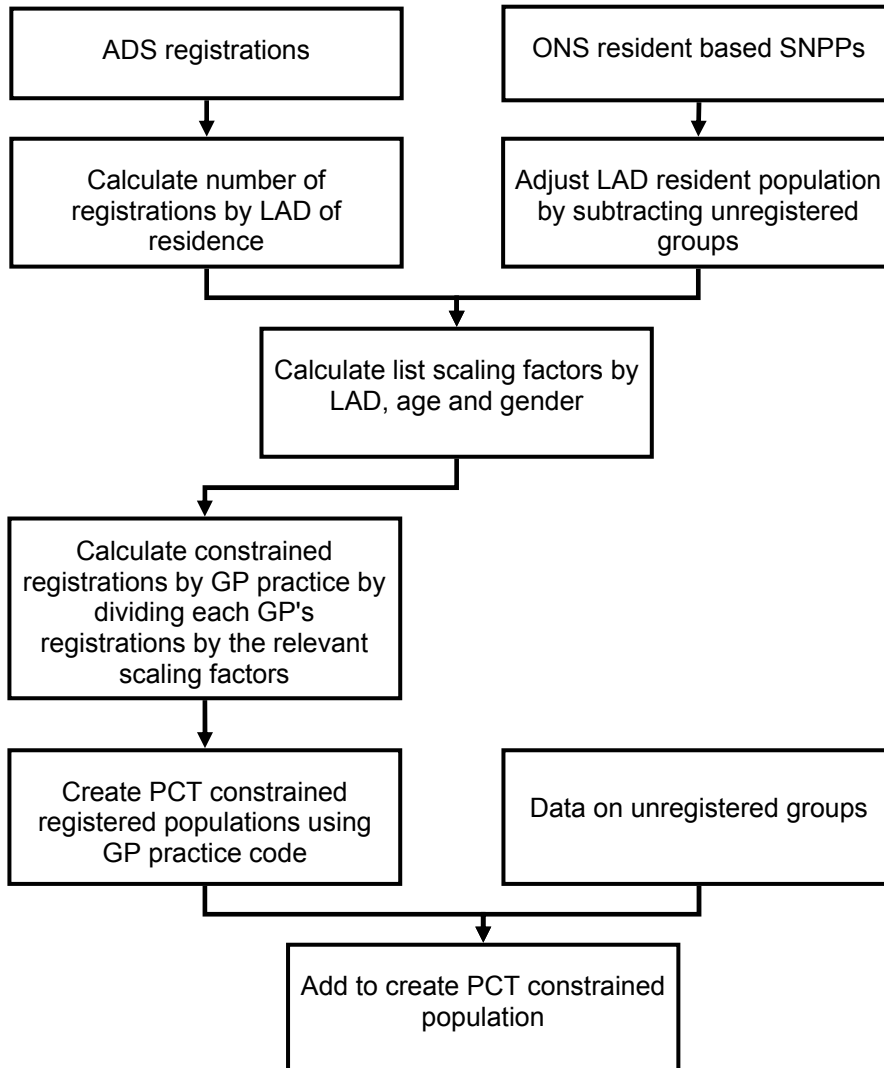
<sup>9</sup> Data for those asylum seekers detained solely under Immigration Act powers are taken from the 2008 4<sup>th</sup> quarter report.

## Resource Allocation: Weighted Capitation Formula

- (b) calculate the number of GP registrations resident in the 376 LADs (354 in England and 22 in Wales) using the home postcode of registered patients in the ADS
- (c) create comparable ONS 2008 based SNPPs for LADs for 2011, which are already resident based, by removing the following unregistered groups using ONS 2008 mid-year estimates (MYEs):
  - (i) prisoners
  - (ii) UK armed forces, foreign armed forces and foreign armed forces dependants
  - (iii) asylum seekers
- (d) compare the ADS constructed number of registrations by LAD of residence with the adjusted ONS 2008 based SNPPs to calculate list scaling factors by age group and gender for each LAD
- (e) for each GP practice, constrain ADS registrations to ONS 2008 based SNPPs by dividing each GP practice's registrations by the relevant list scaling factors (according to the proportion of the GP practice's registrations by age-gender group resident in each LAD)
- (f) create PCT constrained registered populations by aggregating the constrained GP practice lists
- (g) add the following groups of unregistered populations to create total PCT populations for allocations (which in the case of prisoners and asylum seekers have different counts to the populations removed from the ONS 2008 based SNPPs):
  - (i) prisoners
  - (ii) UK armed forces, foreign armed forces and foreign armed forces dependants
  - (iii) asylum seekers in accommodation
  - (iv) asylum seekers receiving subsistence only support
  - (v) asylum seekers receiving Section 4 support
  - (vi) persons detained in removal centres.

63. These steps are schematically represented in Figure 1.

Figure 1: Calculating PCT constrained populations





# Section 3: Hospital and Community Health Service Component

The HCHS component has adjustments for:

- need for acute, maternity, mental health, HIV/AIDS treatment and care and HIV prevention services
- DFLE
- variations in the unavoidable cost of providing healthcare (the MFF and EACA).

## POPULATION

64. The PCT constrained population described in Section 2, before adjustments for need and cost are made, is known as the crude population.

## NEED

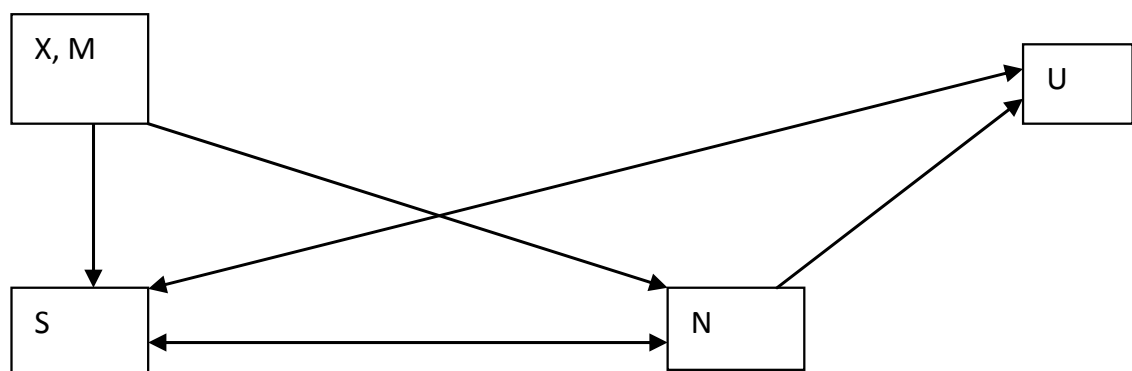
### Introduction

65. Population is the starting point for the calculation of weighted capitation targets but the make-up of the population is also critical. People do not have identical needs for health care. A key difference is that need varies according to gender and age, and in particular, the very young and the elderly, whose populations are not evenly distributed throughout the country, tend to make more use of health services than the rest of the population. The weighted capitation formula therefore takes account of the age structure of local populations.
66. Even when differences due to age and gender are accounted for, populations with the same age and gender distribution display different levels of need. An additional need adjustment to reflect the relative need for health care over and above that related to by age is necessary.

## Resource Allocation: Weighted Capitation Formula

67. Previous formulae have progressively developed a method of measuring need for health care in different areas which is referred to as the small area utilisation approach. This seeks to establish a target equitable share of resources to areas by:
- (a) quantifying the separate effects of various population characteristics on the utilisation of health care services, through the modelling of utilisation across small areas with different population characteristics
  - (b) removing the effects on utilisation of the differential availability of health care facilities between small areas, as these reflect supply rather than need
  - (c) producing a measure of relative need by applying the quantified effects of population characteristics to the actual population characteristics of each area.
68. The approach is illustrated in Figure 2.

**Figure 2: Utilisation approach**



X: socio-economic characteristics  
M: measures of health  
S: supply characteristics  
N: need (unobserved)  
U: utilisation

Source: AREA Report (RARP 26), page 50

69. Underpinning the utilisation approach is the idea that the provision of health care in different areas contains information on relative needs, and that while needs are not observed directly they may be derived from utilisation data using appropriate techniques. The utilisation of services U is determined by needs N and supply factors S. Needs cannot be observed directly but are assumed to be represented by an aggregate of decisions made by health care professionals best placed to assess relative needs subject to resource constraints, and will be strongly



correlated with socio-economic factors X and morbidity M. Hence, by examining the relationship between utilisation and socio-economic status and morbidity after controlling for the effects of supply, the X and M variables are identified that determine needs and the strength of their effect on needs for health care estimated. If the levels of these needs variables in different areas are known it is then possible to use the results from the model to estimate needs in each area and to allocate resources accordingly.

70. Under the utilisation approach, most formulae have used a two stage framework that accounts separately for age related and additional needs. At the first stage, age-gender related needs are calculated by estimating national average levels of use for different age-gender groups. The estimates are then used to adjust crude population counts to give PCT weighted populations that reflect differences in the demographic structure of populations. At the second stage, additional needs (ie needs over and above those pertaining to age and gender) are estimated from a regression model of cost-weighted activity against additional needs indicators and supply variables. The coefficients on the additional needs indicators are used to adjust crude populations to give PCT weighted populations that reflect differences in additional needs. The utilisation data in the second stage are standardised by age and by gender to control for the effect of these.
71. Within the HCHS component, need is modelled separately for five services:
  - (a) general and acute
  - (b) maternity
  - (c) mental health
  - (d) HIV/AIDS treatment and care
  - (e) HIV prevention
72. A weighted population is calculated for each of these components, and then combined into a single weighted population for HCHS as a whole.

#### General and acute

73. The general and acute need model is from research commissioned from a team led by Brunel University and published in the *Combining Age Related and Additional Needs (CARAN) Report* (RARP 30). This formula was introduced for 2009-10 and 2010-11 allocations and is unchanged for 2011-12 allocations.
74. The CARAN Report uses an alternative to the two stage approach based on a one stage approach which estimates age related need and additional need simultaneously. The two stage approach assumes a multiplicative relationship

between age related and additional needs which means the effect of the additional needs adjustment is proportional to the age related need adjustment, with the result that the absolute effect of deprivation on needs will be higher in areas with higher age related needs, and vice versa. A one stage approach for each age group is more flexible than the two stage approach because it allows the effects of the additional need variables to vary independently between age groups.

75. CARAN recommended a stratified one stage acute model which allows the relationship between age and additional need to vary between 18 different age bands (0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85+).
76. The dependent variable in the model is mean cost-weighted activity per head in every age group in every middle layer super output area (MSOA), of which there are 6,781 in England. MSOAs have a minimum population size of 5,000 and a mean population of 7,200.
77. The activity data were taken from Hospital Episode Statistics (HES) returns for 2004-05 and 2005-06. Using two years of data resulted in a more stable dataset than using data for a single year, which is important because some of the age-specific models are based on relatively small number of episodes in some MSOAs.
78. Historically, the activity data from HES used in previous formulae have comprised hospital admitted patients (inpatients and day cases) only. Newly released data from HES on outpatient activity allowed CARAN to include outpatient activity in the model for the first time. CARAN presented evidence that cost-weighted outpatient activity is not proportional to admitted patient activity at the same rate in every area. The addition of outpatient activity allows for a more appropriate measure of need.
79. To combine the data over the full range of types of activity into a single cost figure per head, CARAN used as weights the costs of each type of activity from the 2004-05 National Reference Costs underpinning the 2006-07 National Tariffs. Applying the same unit costs to two years' activity ensured that any difference between the years is not a result of changes in costing policy but due to changes in the geographical distribution of activity only. CARAN applied some features of the 2006-07 Tariff, by including specialist top-ups and adjusting for long lengths of stay using the appropriate trim points and excess bed-day adjustments.
80. The independent variables in the model were selected from a wide range of supply factors that may be expected to influence utilisation (for example, distance from location of treatment or number of GPs in a practice) and need indicators assembled from several sources including births and deaths from ONS, administrative datasets and the Index of Deprivation 2004 (ID2004). The variables

were selected on the basis of statistical criteria, informed judgement and face validity.

81. To ease the presentation of the relative impact of the need indicators, the values of the needs indicators were transformed into z-scores (ie the national mean value of each variable is subtracted from the value for every MSOA and the result divided by the standard deviation of the variable). This means the coefficients shown for the variables in Table 2 represent their relative contribution to the assessment of need.
82. The coefficients in the full acute model, which has a total of 7 supply variables and 12 need indicators across the 18 age groups, is shown in Table 2. Only the needs variables are included in the formula to determine target allocations. The supply variables are sterilised (ie removed by being set at the national average level for every PCT), but nevertheless remain in the underlying model as their omission would otherwise lead to inaccurate estimates of the needs variables that are used to determine resource allocation.
83. The general and acute weighted population is calculated as follows:
  - (a) for each age group, the coefficients are multiplied by the transformed values of each need indicator, for each PCT. These scores are added to the constant term to produce an average cost per head for each age group for each PCT. The following is an example for the 0-4 years age band for PCT A:
    - + 317.6
    - + 202.5 x age-specific death rate for PCT A
    - + 9.5 x standardised proportion aged 16-74 with no qualifications for PCT A
    - + 5.4 x proportion of births that are low birth weight for PCT A
    - + 13.7 x income deprivation score affecting children for PCT A
  - (b) the resulting average costs per person in each age group are multiplied by the population in each age group in PCT A to derive the total cost in each band in PCT A
  - (c) the total costs are summed across all age bands in PCT A
  - (d) this is repeated for all PCTs and the results normalised (ie the figure for each PCT is scaled by the same proportion) so that the total across all PCTs equals the total crude population, to derive an acute weighted population for each PCT.

**Table 2: General and acute model coefficients**

	0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years
<b>Constant</b>	317.6	401.5	378.9	379.6	536.0	328.5	378.3	413.8	476.9
<b>Supply</b>									
Mean waiting time			-0.2	-0.1	-0.2	-0.2	-0.1	-0.2	-0.3
Access to admitted care providers	9.6	9.8	10.6					7.6	13.8
Distance to outpatient providers		-0.6	-0.3				-0.5	-0.6	-0.7
Distance to admitted patient providers	-0.4								
Number of GPs					11.9				5.5
Accessibility score for acute provider capacity									
Accessibility score for outpatient capacity									
<b>Needs</b>									
Age-specific death rate	202.5	541.5	494.5	465.7	883.1	209.5	316.5	344.9	418.0
Standardised no qualifications	9.5	11.9	6.2			23.6	21.5		22.4
Young people not staying in education				13.7	20.6			7.1	
Standardised limiting long-term illness				12.1	14.5			23.9	27.6
Pension credit claimants									
Low birth weight births	5.4								
ID2004: income deprivation affecting children	13.7	10.4							
Disability living allowance claimants under 16			13.0						
New deal for Young People claimants						8.5	6.5		
Disability living allowance claimants						16.3	15.9		
Incapacity Benefit/Severe Disability Allowance claimants								24.5	15.7
Disability living allowance claimants over 60									

Table 2 (continued)

	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85+ years
<b>Constant</b>	492.4	554.0	658.0	818.4	985.2	1,211.2	1,423.9	1,616.5	2,705.0
<b>Supply</b>									
Mean waiting time	-0.6	-0.6	-0.8	-0.9					
Access to admitted care providers	13.4	15.0	22.1	25.7	18.8			66.1	13.6
Distance to outpatient providers	-0.7	-1.0	-0.7	-1.2	-1.7	-1.5		-2.3	
Distance to admitted patient providers									
Number of GPs						10.0			
Accessibility score for acute provider capacity						0.0	0.0		
Accessibility score for outpatient capacity									159.6
<b>Needs</b>									
Age-specific death rate	292.2	285.6	294.1	173.5	211.9	180.2	148.8	117.5	21.8
Standardised no qualifications	27.4	31.0	23.9	20.0			38.2	28.4	
Young people not staying in education									
Standardised limiting long-term illness	32.3	32.8	42.3	33.5					
Pension credit claimants	18.7	25.1	33.3	48.1	65.5	57.5	44.5	33.3	124.1
Low birth weight births									
ID2004: income deprivation affecting children									
Disability living allowance claimants under 16									
New deal for Young People claimants									
Disability living allowance claimants									
Incapacity Benefit/Severe Disability Allowance claimants									
Disability living allowance claimants over 60					36.3	62.1			258.2

## Maternity

84. The maternity model is also from the CARAN Report and unchanged from that introduced for 2009-10-and 2010-11 allocations. CARAN developed a separate model for hospital maternity activity whereas the previous formula had a single model for acute and maternity combined. Separating maternity from the acute model allows the need indicators for both to be different and thus more accurate.
85. The model is based on a cost per birth approach. The mean costs per birth in every MSOA were regressed against supply variables and needs indicators that were selected using the same procedures used for the acute model and transformed into z-scores.
86. The full maternity model is shown in Table 3. However, only the needs variables are included in the formula to determine resource allocation. The supply variable is sterilised but nevertheless remains in the underlying model. The modelled variation in cost per birth is then combined with data on the number of births by PCT to calculate maternity weighted populations. The data on the number of births by PCT are for 2008.

**Table 3: Maternity model coefficients**

Variable	Coefficient
<b>Constant</b>	2308.8
<b>Supply variable</b>	
Capacity at maternity providers	1605.4
<b>Needs variables</b>	
Low birth weight births	24.7
Mean house price	-96.1

87. The maternity weighted population is calculated as follows:
- (a) the relevant coefficients are applied to the transformed scores of each need indicator and aggregated with the constant term to produce an average cost per birth in each PCT, as follows using the example of PCT A:
- + 2308.8  
+ 24.7 x proportion of births that are low birth weight births for PCT A  
- 96.06 x mean house price for PCT A
- (b) the resulting average cost per birth are multiplied by the number of ONS registered births in PCT A to derive the total cost for PCT A

- (c) this is repeated for all PCTs and then normalised so that the total cost across all PCTs equals the total crude population, to derive a maternity weighted population for each PCT.

### Mental health

88. A new mental health formula has been introduced for 2011-12 allocations. This is based on the results of the research undertaken by a team led by Professor Matt Sutton at Manchester University and reported in *Report of the Resource Allocation for Mental Health and Prescribing (RAMP) Project* (RARP 35).
89. The research used a new dataset from the NHS Information Centre, the Mental Health Minimum Dataset (MHMDS)<sup>10</sup>. The MHMDS covers specialist mental health services and allows for the first time models to be developed which include care provided in the community as well in hospitals<sup>11</sup>. The new formula replaces that from the 2002 AREA Report, which covered inpatient hospital care only and which was felt no longer to reflect adequately current mental health service models with their focus on community based care.
90. The model has a two stage approach, with separate adjustments for age and gender and for additional need. The age-gender weights are the national average costs per head constructed using mental health services activity from the 2007-08 and 2008-09 MHMDS,. The different types of activity were combined using the national average costs from the National Reference Cost Schedule 2008-09 as weights.
91. The additional need drivers are likely to be different between working age and older adults, so separate models have been used for each of these two age groups. In keeping with the Information Centre MHMDS publications, the working age population was defined as 16-64 years and older adults as those aged 65 years or over.

### Model for those aged 16 and above

92. Table 4 shows the average costs per capita by gender and age group. The age profiles of costs are different for males and females under the age of 65 years.

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<sup>10</sup> Information on the MHMDS is available at <http://www.ic.nhs.uk/statistics-and-data-collections/mental-health/nhs-specialist-mental-health-services>

<sup>11</sup> The MHMDS data covered by this research included inpatients, consultant services in both outpatient and community settings, the activities of mental health community teams and mental health specialist teams (crisis resolution home treatment teams, assertive outreach teams, early intervention in psychosis services, homeless mental health services, A&E mental health liaison services, crisis accommodation services, emergency duty teams and emergency clinics/walk in clinics) and some mental health secure units (local psychiatric intensive care units, low level secure services and medium level secure services). Source RAMP report, section 2.3.1

Costs rise with age at a similar rate for males and females amongst the population aged over 65 years.

**Table 4: Mental health: average costs per head by age and gender**

Age group	Female (£)	Male (£)	Average males and females (£)
16-19	38.25	44.91	41.67
20-24	59.98	101.77	81.40
25-29	78.97	131.12	105.74
30-34	87.87	134.07	111.21
35-39	93.86	135.38	114.64
40-44	93.90	125.23	109.53
45-49	97.48	111.33	104.31
50-54	87.72	96.37	92.00
55-59	83.73	83.91	83.82
60-64	78.80	78.15	78.48
65-69	89.43	83.00	86.33
70-74	115.79	97.69	107.25
75-79	154.52	134.04	145.25
80-84	183.70	165.98	176.35
85+	170.13	161.14	167.11

Source: RAMP Report table 2.3 for males and females, DH calculation for all persons

93. In the formula the age weights for males and females combined were used given the complexity of the overall formula for mental health. Further consideration will be given to separate age-gender weights for allocations in future years.
94. In order to derive an age index, the average age weights in Table 4 are multiplied by the population in each age group in each PCT, and the outcomes then summed across all age bands to give a total figure for each PCT. The total for all PCTs is normalised to the total crude population to give the mental health age weighted population for each PCT. This is then divided by each PCT's crude population to give a mental health age index for each PCT. An age weighted index is calculated separately for people of working age and for older adults.
95. The additional need adjustment is based on a model of utilisation of mental health services, and comprises a number of socio-economic and health related variables and supply variables. These are shown in Tables 5a and 5b with their statistically estimated coefficients for the working age and older age models respectively. These are the full models. However, only the need variables are included in the formula to determine target allocations. The supply variables are sterilised by setting their value to the national average for each PCT, but remain in the underlying model as the need variables would otherwise be biased.



**Table 5a: Working age mental health model coefficients**

Variable	Coefficient
<b>Constant</b>	0.830
<b>Supply variables</b>	
Proportion providing informal care	11.783
Contains MH provider	2.739
Distance to CMHT base	-0.074
<b>Needs variables</b>	
IB/SDA with mental health diagnosis	36.026
SMR (where a mental illness excluding dementia is indicated)	0.074
Proportion Black	2.155

**Table 5b: Older adults mental health model coefficients**

Variable	Coefficient
<b>Constant</b>	0.567
<b>Supply variables</b>	
Proportion providing informal care	-7.020
Contains MH provider	2.312
Distance to CMHT base	-0.110
<b>Needs variables</b>	
SMR (where a mental illness is indicated)	0.542
Population aged 60+ that are single pension credit claimants	1.251

## Notes:

1. CMHT stands for Community Mental Health Team, IB incapacity benefit and SDA severe disablement allowance.

2. Unlike the CARAN Report, the values of the variables have not been standardised, so their coefficients in the tables do not necessarily represent their relative size – the values of the variables need also to be taken into account.

Source: RAMP Report tables 2, 12 and 2.13.

96. The additional mental health need index is calculated as follows for those of working age (and similarly for older adults):

+ 0.830

+ 36.026 x proportion claiming IB/SDA with mental health diagnosis for PCT A

+ 0.074 x SMR (where a mental illness excluding dementia is indicated) for PCT A

+ 2.155 x proportion of population who are Black for PCT A

97. The result is multiplied by PCT A's crude population of working age. This calculation is repeated for all PCTs, and the outcomes normalised (ie the figure for each PCT is scaled by the same proportion) so that the total across all PCTs

## Resource Allocation: Weighted Capitation Formula

equals the total crude population, to derive a working age mental health additional need weighted population for each PCT. This is then divided by each PCT's crude population to give the working age mental health additional need index.

98. The mental health age index and additional need index are simultaneously multiplied by the crude population of each PCT and the results normalised to the total crude population to derive the mental health weighted population of each PCT. As noted above, this is undertaken separately for those of working age and older adults to give a working age weighted population and an older people's weighted population.

### Model for those aged under 16

99. The MHMDS does not cover those aged under 16. A weighted population for the under 16s was obtained by
  - (i) using inpatient and outpatient activity reported in HES for 0-4 year olds relative to 5 to 15 year olds for the age weights, and
  - (ii) using the working age model for additional need.

### Combining the age groups

100. The final step is to combine the three mental health weighted populations for under 16s, working age adults and older adults into a single weighted population for mental health. This is undertaken using relative expenditure for each of the three as the weights. The weights are:

Under 16s	–	7.1%
Working age	–	69.6%
Older adults	–	23.4%

101. The weight for those aged under 16 is the share of total mental health expenditure on child and adolescent mental health services (CAMS) as reported in 2008-09 Programme budgeting data. The relative weights working age and older adults is based on data from the RAMP study.

### HIV/AIDS treatment and care

102. An epidemiological approach is possible using the Survey of Prevalent HIV Infections that are Diagnosed (SOPHID) conducted annually by the Health Protection Agency (HPA). This gives the number of HIV infected persons by PCT of residence seen for HIV related care at NHS sites. 2008 SOPHID data for each PCT are normalised so the sum across all PCTs equals the total crude population

for all PCTs. This gives the HIV/AIDS treatment and care weighted population for each PCT.

### HIV prevention

103. A HIV prevention weighted population is calculated by normalising to the total PCT crude population:
- (a) the 15-44 year old population and weighting this by 60%
  - (b) the 2008 SOPHID data and weighting this by 40%.
104. These weightings were informed by the *UK Health Departments' HIV and AIDS Health Promotion: An Evolving Strategy* (1995), which concluded that although there remained a need for HIV prevention work for the general population, some emphasis should be placed on developing work directed at vulnerable groups.

### Other HCHS services

105. The CARAN Report, and earlier AREA Report, was not able to produce well specified models for community health services and people with learning disabilities due to data limitations. Specialist mental health community services are now covered in the RAMP mental health formula.

### DFLE formula (formerly the health inequalities formula)

106. The current aims of resource allocation are to provide equal access to healthcare for people with equal need and to contribute to the reduction in avoidable health inequalities.
107. The need models described above, which are generally based on the small area utilisation approach, meet the first objective of equal access for equal need. ACRA considered them less successful at meeting the second objective of reducing avoidable health inequalities. There are two key reasons for this:
- (a) the utilisation approach cannot capture unmet need (or more precisely, differentially met need). If unmet need is more common amongst those with the poorest health status, this is a fundamental problem
  - (b) current patterns of utilisation, especially of hospital based services, are largely driven by the NHS's response to the current patterns of health status. They are not sufficiently focussed on reducing the current levels of health inequality.

## Resource Allocation: Weighted Capitation Formula

108. There have been several attempts to allocate resources more directly in line with the objective of reducing avoidable health inequalities introduced in 1999. These are covered briefly in Section 1.
109. For 2009-10 and 2010-11 allocations, a separate formula was introduced (previously referred to as the health inequalities formula). This used DFLE as its measure, combining 2005 life expectancy data with 2001 limiting long-term illness (LLTI) data, and so capturing morbidity as well as mortality. It is a measure of the number of years from birth a person is expected to live which are free from limiting long-term illness and disability. It was applied by comparing every PCT's DFLE to a benchmark figure of 70 years. For example, a PCT with a DFLE of 60 years is given an index of 10. This value was multiplied by each PCT's crude population and the results normalised to the total crude population to give the DFLE weighted population for each PCT. The same formula has been used for 2011-12 allocations.

## Weighting the need and DFLE formulae

110. The breakdown of current gross expenditure on HCHS in 2008-09 shown in Table 6 is used to inform the weights used to combine each of the separate HCHS need weighted populations.

**Table 6: HCHS gross current expenditure 2008-09**

	£m	%
General and acute	31,059	55.7
Mental illness	7,824	14.0
Maternity <sup>12</sup>	2,562	4.6
Accident and emergency	1,856	3.3
Learning difficulties	2,428	4.4
Community health services	7,105	12.7
Other contractual	2,300	4.1
HIV/AIDS	650	1.2
<b>Total HCHS</b>	<b>46,853</b>	<b>100.0%</b>

Sources: Summarised Account of Primary Care Trusts 2008-2009<sup>13</sup>  
2008-09 programme budgeting data

111. The needs models are applied to this expenditure as follows:

<sup>12</sup> The source data have been adjusted by transferring £594m for neonates (source: 2008-09 programme budgeting data) from general and acute to maternity, in order to reflect the coverage of the respective models.

<sup>13</sup> *NHS (England) summarised accounts 2008-2009: summarised accounts of strategic health authorities, primary care trusts and NHS trusts, for the year ended 31 March 2009* available from <http://www.official-documents.gov.uk/document/hc0809/hc10/1033/1033.asp>

- (a) the general acute model is applied to both general and acute and community health services expenditure
  - (b) the maternity, mental health and HIV/AIDS models are applied to their respective expenditure
  - (c) the general and acute model and mental health model are applied to remaining expenditure – accident and emergency, learning difficulties and other contractual – in proportion to their relative share of expenditure.
112. ACRA considered a number of approaches for determining the weight for the DFLE formula, including the proportions of a range of categories of health service expenditure that normatively should be spent on reducing health inequalities, the effectiveness of health services expenditure in reducing health inequalities, and lessons from the Spearhead areas. ACRA concluded it is not currently possible on a technical basis to determine the weighting and the weighting should be for Ministers to determine.
113. For 2011-12 PCT allocations, Ministers decided to apply the DFLE formula to 10% of allocations, excluding HIV/AIDS.
114. The 80% weighting for HIV/AIDS treatment and care and 20% weighting for HIV prevention, relative to total expenditure on HIV/AIDS, reflect the separate funding that was made available for these services before they were mainstreamed within general allocations in 2002-03.
115. Table 7 shows the resulting weights. The derivation of the weights in Table 7 from Table 6 is included in the 2011-12 Exposition Book.

**Table 7: HCHS need and DFLE weights**

	%
Acute	70.3
Maternity	4.2
Mental health	14.4
HIV/AIDS treatment and care	1.0
HIV prevention	0.2
DFLE	9.9
<b>Total HCHS</b>	<b>100.0</b>

## UNAVOIDABLE COST

### Market Forces Factor

#### Introduction

116. The weighted capitation formula has to take account of the fact that the cost of commissioning or providing healthcare is, unavoidably, not the same in every part of the country. The MFF is therefore included in the weighted capitation formula to compensate for these unavoidable costs. Under PbR, a MFF is included also in the tariffs paid to providers.
117. The MFF consists of four separate elements for:
- (a) staff (excluding medical and dental)
  - (b) medical and dental (M&D) London pay weighting
  - (c) buildings
  - (d) land.
118. Separate indices for each of these are calculated and then combined into an overall index for both provider Trusts and PCTs. Other costs (equipment, consumables, drugs etc) are assumed not to vary across the country.

#### Staff MFF (exclusive of medical and dental staff)

119. Economic theory underpins the staff MFF. The theory predicts that it is more expensive to employ staff in some areas, notably London, than others, due to market forces. Competitive wages will rise or fall according to the cost of living, plus the relative amenity of different geographical areas.
120. In the NHS, where wages are determined by national pay structures, Trusts in areas with a relatively low cost of living and low local market wage rates (low MFF areas) will be paying above the going rate for staff, in contrast to Trusts in relatively high cost and high wage areas (high MFF areas) which will be paying staff below the market rate.
121. The theory predicts that this asymmetry between NHS and general labour markets will lead low MFF areas to attract relatively more staff of better quality, who will stay longer, reflecting better recruitment and retention conditions. The outcome is expected to be higher productivity, lower turnover and fewer vacancies. Conversely, the theory predicts that high MFF areas will attract a relatively poorer quality workforce and experience greater difficulty in recruitment and retention,

reflected in higher turnover rates, increased reliance on bank and agency staff and lower productivity. Economic theory also suggests that the NHS wage in high MFF areas will have a tendency to drift upwards (as employers strive to recruit) and be measurably higher for the same role than wages in low MFF areas.

122. Two methods of estimating the staff MFF are available:
- (a) the Specific Cost Approach (SCA), which is based on the actual costs borne by NHS organisations
  - (b) the General Labour Market (GLM) approach, which is based on geographical variations in pay rates in the private sector.

#### Specific Cost Approach

123. The SCA approach was most recently reviewed by a team led by Crystal Blue Consulting Ltd in 2007, and reported in *Review of Specific Cost Approach to Staff Market Forces Factor* (RARP 31). This study represents the most detailed attempt to date to investigate the SCA in relation to an area cost adjustment in the NHS or government services generally.
124. The study was divided into a micro study of Trusts with different MFF rankings, and a macro study using national datasets on NHS costs. It had three main conclusions:
- (a) spatial variation in staff costs reflected the pattern of the existing staff MFF. With the exception of medical staff, the researchers therefore found strong evidence to support the use of a GLM approach as a proxy for NHS unavoidable costs
  - (b) it was virtually impossible to separate avoidable and unavoidable cost differentials from Trusts' financial records, partly due to cause and effect (the costs under investigation were at least part the product of resource allocation already shaped by the staff MFF)
  - (c) the feasibility of implementing the SCA as an alternative to the current GLM method was rejected on the grounds of cost and practicality (the absence of a suitable nationally available dataset), the lack of a unified methodology, and conceptual problems with cause and effect.

#### General Labour Market approach

125. The staff MFF has always been based on the GLM approach and was most recently updated by a team led by HERU of the University of Aberdeen. Their report is *The Staff Market Forces Factor Component of the Resource Allocation*

## Resource Allocation: Weighted Capitation Formula

*Weighted Capitation Formula: New Estimates (RARP 34a)* which employs the same methodological approach as their earlier study used for 2009-10 and 2010-11 allocations (*Review of the Market Forces Factor Following the Introduction of Payment by Results (2005): Exploring the General Labour Market Approach (RARP 32)*).

126. The GLM approach is based on variation in wages in the private sector as a proxy for the variation in indirect staff costs faced by providers and commissioners in different parts of the country, such as vacancy rates, staff turnover rates, and use of agency staff.
127. The GLM approach uses a multiple regression analysis of earnings data for the private sector. Economists have been studying the pattern of wage differentials for many years. The work shows that average wages exhibit substantial variation between areas because of differences in the composition and skills of the workforce in different areas. In order to isolate the impact of location alone it is necessary to control for these other factors, and therefore the regression equation has the following general form:

$$\begin{aligned} \text{Log (earnings)} = & a + \sum b_i (\text{age dummies}) + \sum c_j (\text{industry dummies}) \\ & + \sum d_k (\text{occupational dummies}) + e (\text{sex dummy}) \\ & + \sum g_f (\text{area dummies}) \end{aligned}$$

128. The dependent variable is hourly wages, calculated by dividing the gross weekly pay in the reference week by the sum of basic and overtime hours worked during the reference week. The sample includes employees aged 16 to 70 whose pay had not been affected by absence during the reference week.
129. The explanatory variables are age, gender, industry, occupation and geographical work area. These explanatory factors have been singled out in economic research as systematic influences on earnings, and after controlling or standardising for the influence of age, gender, industry and occupation, it is possible to isolate the independent effect of work area on relative earnings – the coefficients  $g$  on the area dummies in the above equation. These are known as Standardised Spatial Wage Differentials (SSWDs).
130. The updated SSWDs from the HERU research were calculated using anonymised, individual level data from ONS's Annual Survey of Hours and Earnings (ASHE) for the three years 2007 to 2009. The then 152 PCTs were used as the relevant geography in the modelling. Employees in the ASHE sample in Wales and Scotland were included in the estimates of the SSWDs for England and in the smoothing options. This increases the robustness of the estimates of SSWDs and the validity of smoothing, especially for PCTs near the borders with Wales and Scotland (smoothing is defined below).



131. Jobs with the same title often have different roles and levels of responsibility according to the size of firms and managerial role. There will be greater managerial responsibility in areas with higher proportions of large firms, such as metropolitan areas. For example, a banker in central London is likely to have a different role than a banker in a different part of the country. The HERU research applied a job responsibility adjustment to take account of these differences. This adjustment acknowledges the relationship between higher responsibility and higher wages. Data for this adjustment are not available in the ASHE survey, but are available in the Labour Force Survey (LFS). As the LFS has a smaller sample size than ASHE, the job responsibility adjustment was estimated at Government Office Region level rather than at PCT level.

### Smoothing

132. The MFF methodology often results in 'cliff edges,' which is when neighbouring PCTs have markedly different SSWDs. This is because PCTs' geographical boundaries do not necessarily correspond to local labour markets and statistical variation arising due to relatively small sample numbers in ASHE for some PCTs. These discontinuities may lead to inequitable MFFs, particularly for providers in close proximity and facing similar local labour market pressures but which are in different PCTs. Smoothing techniques, a form of averaging, soften cliff edges to produce a more continuous profile of SSWDs across PCTs.
133. The HERU team recommended that smoothing should take into account the SSWDs of all PCTs rather than just the neighbouring ones, as was the case for the staff MFFs prior to 2009-10, to recognise the fact that NHS organisations in one PCT might draw their labour force from a variety of PCT areas. The smoothed SSWDs for a given PCT is the weighted average of the SSWDs for all PCTs, with the PCT in question having the highest weight, and the weights of the SSWDs of the surrounding areas falling with distance from the base PCT. The rate at which the weights fall as distance increase is governed by an exponential distance decay function which has the following form:

$$\exp(-cd)$$

where  $d$  is the distance from each PCT's geographical centroid and  $c$ , which has a value of 0.01, is the constant that controls the influence that distance has on the weights. The smoothed SSWDs give the values of PCTs' staff MFFs for services provided from many sites across the whole of the PCTs' geographical areas (termed 'host' services below, paragraph 147).

134. Smoothing brings each PCTs' MFF more in line with those of its neighbours. It also increases the sample size, reduces the confidence interval around the estimate and reduces instability. Exponential smoothing gives proportionately

## Resource Allocation: Weighted Capitation Formula

more emphasis to those areas in closer proximity than those further away. This is what would be expected if labour markets could be accurately observed.

### Interpolation

135. Under PbR the MFF is paid to NHS Trusts as part of the tariff in respect of the activity they carry out. The MFF therefore has a direct impact on Trust income. If Trusts are assigned the smoothed SSWDs for PCTs described above for the PCT where they are located, this would still result in cliff edges between the MFFs for Trusts.
136. There is likely to be spatial variation of pay rates within the PCT areas that have been used to construct the SSWDs, and Trusts are not located across a whole PCT area but at a point within the area. The going local labour market rate of pay faced by a Trust may therefore differ from that for the PCT as a whole. For example, two Trusts operating near the border of neighbouring PCTs might have different MFFs (if assigned those of their PCT areas) but operate in the same labour market.
137. Interpolation is a technique that uses two or more values to create an intermediate value. It is in effect a second stage smoothing carried out at Trust site level, after smoothing at PCT level, to reduce further cliff edges for providers. It works the same way as smoothing in that the MFF of a Trust is the distance weighted average of the surrounding PCTs' MFFs.
138. Interpolation is carried out at Trust site level. Where a Trust has more than one site, the different indices after interpolation for each site are weighted together in proportion to activity on each site. The most consistent indication of activity by site held centrally is the 2008-09 Estates Return Information Collection (ERIC) return on numbers of beds. The interpolation of the smoothed PCT MFFs gives the relative MFF index for each provider Trust.
139. Ambulance Trusts are assigned a MFF based on the (population weighted) average MFFs of the PCT areas they serve.

### Medical and dental London pay weighting

140. A MFF based on pay rates in the private sector is not applied to expenditure on medical and dental staff. Both the *Review of the Market Forces Factor Following the Introduction of Payment by Results (2005): Exploring the General Labour Market Method* (RARP32) and the *Review of Specific Cost Approach to Staff Market Forces Factor* (RARP 31) found strong evidence that the GLM is inappropriate for medical and dental staff, because their indirect costs do not vary differentially across the country as they do for other NHS staff. Instead there is a separate index based on the direct, higher costs of employing medical and dental

staff in London, ie on the London pay weighting. It is calculated as the ratio of the average pay bill per doctor for hospital doctors in 2008-09 including London pay weighting to the average pay bill excluding the London pay weighting, and then applied to Trusts in London.

#### Building MFF

141. The buildings index uses relative location factors calculated by the Building Cost Information Service (BCIS) from an analysis of tender prices for public and private contracts at LAD level. BCIS provided a set of average location factors for the period between January 2007 and June 2010 for the then 152 PCTs.
142. Provider Trusts were assigned values depending on the PCT in which they are located, with account taken of multi-site Trusts in the same way as for the staff MFF.

#### Land MFF

143. A land index based on land value per hectare is calculated for each NHS Trust and PCT. This uses the net book value of land at 31 March 2009 reported in the audited summarisation schedules of PCTs and Trusts 2008-09. Monitor provided the same data for NHS Foundation Trusts. The land values were divided by land areas from 2008-09 ERIC returns to give relative land value per hectare. These are turned into an index in which national average land value per hectare has the index value of one.
144. There are two technical adjustments made in the calculation of this index. A small number of PCTs do not own any land due to leases and two trusts had net book values of zero. In these cases the relevant county average is assigned. Second, two central London Trusts that also have a significant non-London site have land indices weighted in proportion to activity on each site (to reflect that land is used more intensively in central London compared to less urban areas).

#### Providers' overall MFFs

145. An overall MFF is calculated for each provider by combining the four separate MFF indices for staff (exclusive of medical and dental staff), medical and dental staff London pay weighting, buildings and land. The relative weights for each of these elements are national expenditure as shown in Table 8, based on an analysis of 2008-09 expenditure from the financial returns and accounts of PCTs, NHS Trusts and NHS Foundation Trusts. The reason for using national expenditure weights is so that local decisions on the mix of inputs do not affect PCT target allocations or PbR tariffs.

**Table 8: HCHS MFF weights**

	%
Staff	54.9
Medical and dental London weighting	13.9
Buildings	2.7
Land	0.4
Other	28.1
<b>Total HCHS</b>	<b>100.0</b>

### Final MFF index for PCTs

146. Each PCT's final MFF is comprised of two elements:
- (a) the MFFs for each of the providers from which it commissions. This is designated non-host provision. The weights are calculated through a purchaser-provider matrix (PPM)
  - (b) in the case of maternity and community programmes it is assumed that they are provided wholly within the host PCT's geographical area and across many sites within the PCT's area. These are designated host provision and assigned the MFF for the PCTs' geographical area (which is after smoothing has been applied).
147. The PPM is derived from the application of 2009-10 mandatory PbR tariffs to admitted patient and outpatient care activity data by commissioning PCT from 2008-09 HES. The HES data only provide information on admissions to NHS hospitals and outpatients. There are no equivalent national datasets for other HCHS programmes which allow providers to be mapped to PCTs. To overcome this, it is assumed that most other programmes follow the pattern of inpatients and outpatients.
148. The final, overall MFFs for each element for PCTs are from combining the MFF for host and MFF for non-host activity. As described above, provider MFF indices are passed through the PPM to which a non-host weight of 81.1% is applied (derived from the 2008-09 HCHS expenditure excluding maternity, community health services and HIV/AIDS in Table 6)<sup>14</sup>. The weight for host provision is 18.9% (from maternity, community health services and HIV/AIDS expenditure in Table 6).

<sup>14</sup> The derivation is set out in the 2011-12 Exposition Book and differs from the shares in Table 6 due to baseline changes.

## EMERGENCY AMBULANCE COST ADJUSTMENT

149. The EACA was introduced for 1998-99 allocations. It reflects the unavoidable cost variations of delivering emergency ambulance services in different areas.
150. EACA had its origins in a study of rurality and unavoidable cost commissioned from a joint team of researchers from Mallender Hancock Associates (MHA) and Operational Research in Health Ltd. The results of the research were reported in the *Study of Costs of Providing Health Services in Rural Areas* which is available as RARP 14.
151. The research produced a model that explained unit costs for emergency ambulance services.
152. Three drivers were combined to produce a single EACA index:
- (a) a rurality index: a 1 per cent increase in rurality led to a 0.23 per cent increase in costs per journey
  - (b) a scale effect: a 1 per cent increase in the total number of journeys led to a 0.17 per cent decrease in unit costs
  - (c) a case-mix effect: a 1 per cent increase in emergencies as a proportion of total journeys added a premium of 0.96 per cent to unit costs.
153. The rurality index was based on standard Health Authority (HA) boundaries and referred to 1991 Census resident populations. Unit cost data and journeys data were based on 1995-96 HA outturn data. Emergency journey proportions were based on the KA34 ambulance return.
154. The values for Birmingham HA and Herefordshire HA are illustrated in Table 9.

**Table 9: EACA values for Birmingham and Herefordshire**

	Rurality index	Total number of journeys	Emergency journeys as a proportion of total journeys	EACA need factor $A^{-0.23} \times B^{-0.17} \times C^{0.96}$
Birmingham	37.67	113,148	0.69	0.04
Herefordshire	2.50	9,791	0.64	0.11

155. The HA values have been mapped to PCTs, and, as for other adjustments, the EACA need index is multiplied by each PCT's crude population, the product of which is normalised to the total crude population to produce an EACA weighted population.

## HCHS WEIGHTED POPULATION

156. Dividing the normalised weighted population for each adjustment by the crude population generates a separate index, comparing the PCT score on the adjustment to a mean value of 1. An overall index of need (reflecting acute, maternity, mental health, HIV/AIDS treatment and HIV prevention need, and DFLE formula), an MFF index and an EACA index are created. To calculate the HCHS weighted population, each PCT's crude population is simultaneously multiplied by these indices as follows:

Weighted population = Population x Need Index x MFF Index x EACA Index

157. The results of this calculation are normalised to the total crude population.

# Section 4: Prescribing Component

The prescribing component has adjustments for:

- age and gender related need
- additional need, over and above that related to age and gender
- DFLE

It does not have an adjustment for unavoidable costs.

## POPULATION

158. The prescribing component uses the same crude populations as the HCHS component, other than excluding prisoners, members of the UK armed forces, and members of foreign armed forces and their dependants<sup>15</sup>.

## AGE AND GENDER RELATED NEED

159. The adjustment for age and gender uses weights developed by the PSU at the Information Centre from an analysis of total prescription cost data of 130 English practices over a one-year period. They are known as Age, Sex, Temporary Resident Originated Prescribing Units (ASTRO(09)-PUs) and are shown in Table 10. These replace the ASTRO(97)-PUs used for 2009-10 and 2010-11 allocations. There is no longer a separate weighting for temporary registrations within the ASTRO-PUs.

**Table 10: ASTRO(09)-PUs**

Age band	0-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+
Male	1.0	1.1	1.4	1.8	2.9	4.9	9.2	15.9	21.1
Female	0.8	1.0	2.0	2.8	4.0	6.1	9.6	14.5	18.5

## ADDITIONAL NEED

160. A 'two stage' utilisation approach is employed for prescribing. The first stage adjustment for age and gender uses the ASTRO(09)-PU weights. The second stage adjustment for additional need over and above age that relating to age and gender is from the new model developed by a team led by Professor Matt Sutton,

<sup>15</sup> This is explained in paragraphs 53 and 57.

## Resource Allocation: Weighted Capitation Formula

and reported in *Report of the Resource Allocation for Mental Health and Prescribing (RAMP) Project (RARP35)*.

161. The analysis was undertaken at GP practice level. The dependent variable is the cost of the drugs dispensed in every practice in England in 2008-09, standardised to account for the age and gender distribution of the patients registered with the practice.
162. A range of need and supply variables were collated and those included in the final, preferred model were chosen on the basis of the statistical robustness of the models. Several of the independent variables were available directly at practice level, while other variables were attributed to practices from lower layer super output areas (LSOAs) using the ADS. The practice-level variables are marked ‘\*\*’ in Table 11. The independent variables are untransformed, hence the values of the coefficients cannot be directly compared to assess the relative impact in the variables; the different values of the independent variables themselves also need to be taken into account.
163. Table 11 shows the full model. However, only the need variables are included in the formula to determine target allocations. The supply variables are sterilised, (ie set at the same national average value for every PCT), but remain in the underlying model.

**Table 11: Prescribing model coefficients**

Variable	Coefficient
Constant	0.333
<b>Supply variables</b>	
Dispensing practice*	0.036
One-partner practice*	-0.045
Proportion UK qualifies GPs in practice*	0.045
Average GP age in practice*	-0.001
Potential generic savings*	3.682
Proportion outpatients seen <4 weeks	-0.096
<b>Need variables</b>	
LISI (2008)*	0.006
Proportion >75 years who are >85 years (2008)*	0.235
Proportion >70 years claiming DLA (2008)	0.855
SMR (all ages) (2004-2008)*	0.114
Generalised fertility rate (2004-2008)*	0.979
Age-standardised CHD prevalence (2007/8)*	0.157
Age-standardised Diabetes prevalence (2007/8)*	0.052
Age-standardised Hypertension prevalence (2007/8)*	0.079



- \* Denotes variables that are calculated directly for practices rather than being attributed from small areas using the ADS.  
*Source: RAMP Report table3.2, Model 4.*

164. The prescribing additional need index is calculated as follows:

- + 0.333
- + 0.006 x LISI value for PCT A
- + 0.235 x Proportion >75 years who are >85 years for PCT A
- + 0.855 x Proportion >70 years claiming DLA for PCT A
- + 0.114 x SMR (all ages) for PCT A
- + 0.979 x Generalised fertility rate for PCT A
- + 0.157 x Age-standardised CHD prevalence for PCT A
- + 0.052 x Age-standardised Diabetes prevalence for PCT A
- + 0.079 x Age-standardised Hypertension prevalence for PCT A

165. The result is multiplied by PCT A's crude population. This calculation is repeated for all PCTs and the outcomes normalised (ie the figure for each PCT is scaled by the same proportion) so that the total across all PCTs equals the total crude population. The additional need weighted population for each PCT is divided by each PCT's crude population to give the additional need index.

### DFLE FORMULA (FORMERLY THE HEALTH INEQUALITIES FORMULA)

166. The DFLE formula is applied in the same way as described in the HCHS component and given a weighting of 10%.

### UNAVOIDABLE COSTS

167. The prescribing component does not have an adjustment for unavoidable costs since the prices of drugs do not vary by geographical location.

### PRESCRIBING WEIGHTED POPULATION

168. An age-gender index and an additional need (including the DFLE formula) index are created. To calculate the prescribing weighted population, the crude population of each PCT is simultaneously multiplied by these indices and the results then normalised so that they sum to the total crude population.



# Section 5: Primary Medical Services Component

The primary medical services component has adjustments for:

- age and gender related need
- additional need, over and above that related to age and gender
- DFLE
- variations in the unavoidable cost of providing healthcare (Market Forces Factor).

## POPULATION

169. The primary medical services component uses the same crude populations as the HCHS component, other than excluding prisoners, members of the UK armed forces, and members of foreign armed forces and their dependants<sup>16</sup>.

## AGE AND GENDER RELATED NEED

170. The age and gender related need adjustment is based on research used to derive the new General Medical Services (GMS) Global Sum Formula for the GP contract from 2004-05, reported in *GMS contract: workload formula* (RARP 27). The age and gender related adjustment is unchanged from that for the allocations for 2009-10 and 2010-11.

171. Table 12 shows the age-gender workload index, which is based on an estimate of GP consultations in minutes per year per patient for each age-gender group, expressed as the ratio to that for males aged 5-14.

**Table 12: Age-gender workload index**

	0-4	5-14	15-44	45-64	65-74	75-84	85+
Male	3.97	1.00	1.02	2.16	4.23	6.01	7.22
Female	3.64	1.04	2.20	3.37	4.95	6.95	8.85

172. GP consultations can take place in the surgery, the patient's own home or in a nursing or residential care home. The age-gender workload index is derived from

<sup>16</sup> This is explained in paragraphs 53 and 57.

## Resource Allocation: Weighted Capitation Formula

separate analyses of consultations in the surgery and home visits, with an adjustment for nursing and residential home consultations.

### Consultations in the surgery

173. The analysis of surgery consultations is based on the General Practice Research Database (GPRD) which includes data from 240 practices (220 of which are in England). Sixty-eight million patient file openings between 1999 and 2001 were analysed.
174. Annual practice workload for each age-gender group was estimated by the average total time a patient file was opened by all members of the primary healthcare team, weighted by an average staff input cost factor.

### Home visits

175. A large proportion of consultations with very elderly patients take place in the patient's home rather than in the surgery. The GPRD does not systematically record home visits. Although there may be a patient file opening corresponding to home visits, this is likely to be very short as the information will be added after the home visit has taken place. It is also unlikely to reflect the full workload of home visits, which are often longer than surgery consultations and have an associated travel time. For this reason, home visits have been treated separately.
176. The proportion of total consultations accounted for by home visits was taken to be 6.4%, based on the 2000 General Household Survey (GHS). Home visit rates by age and gender were taken from the 1991-92 Morbidity Statistics for General Practice 4 (MSGP4). These rates were multiplied by a consultation length of 25.2 minutes (13.2 minutes for the average consultation and 12 minutes for the average travel time) from the 1992-93 General Medical Practitioner's workload survey.
177. Home visit lengths were added to patient file openings for surgery consultations to estimate the workload in minutes per year per patient for each age-gender group.

### Nursing and residential homes

178. Nursing and residential home visits are adjusted for separately.
179. Although the GPRD included nursing and residential home residents, their consultation times would have been underestimated for the same reason as they were for home visits. It was assumed they were recorded at 10%<sup>17</sup> of their actual length (eg 1 minute instead of 10 minutes). An adjustment to the age-gender

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<sup>17</sup> The 10% assumption makes the consultation length broadly consistent with average consultation length. Sensitivity analysis suggests that any reasonably plausible assumption makes little difference to the results.

workload index was made for these consultations by taking the percentage of the population in each age-gender band in care homes and uprating to the assumed consultation length. Figures from the 2001 census were used to estimate the percentage of people in each age-gender band in care homes. For those aged 85 and over this was 10.3% for men and 19.6% for women, 2.5% and 4.3% respectively for those age 75-84 and less than 1% for all other ages.

180. The unadjusted age-gender workload index multiplied by the percentage of the population not in care homes, added to the same index multiplied by the percentage of the population in care homes and a factor of 1.43, which represents the average extra workload for all patients in nursing and residential homes, gives the figures in Table 12.

## ADDITIONAL NEED

181. The additional need adjustment is based on research used to derive the new GMS Global Sum Formula for the GP contract from 2004-05. The report is *An analysis of the factors predicting GP consultations: a small area level analysis using Health Survey for England (HSE) data* (RARP28). The additional need adjustment is unchanged from that for 2009-10 and 2010-11 allocations.
182. The modelling used HSE data between 1998 and 2000. The HSE asks survey respondents whether they have had a GP consultation in the past two weeks, and if yes the number of such consultations. The survey also includes information on age, gender, geographic location and a range of socio-economic indicators. These were combined with a range of other small area level explanatory variables, including census data, mortality rates, and supply variables. The analysis was conducted at ward level, and wards were excluded where there were less than five observations in the ward. This reduced the sample size to 2,404 wards.
183. Table 13 shows the variables, with their statistically estimated coefficients, which were found to be significant and the best at explaining variations in workload over and above age and gender.

**Table 13: Primary medical services additional need coefficients**

	Coefficient
Standardised limiting long-term illness (SLLTI)	0.2612
Standardised mortality ratio for those aged under 65 (SMR<65)	0.2368

## Resource Allocation: Weighted Capitation Formula

184. They are related to workload by the following calculation (which also includes a constant term of 48.1198) for each PCT:

$$\begin{aligned} &+ 48.1198 \\ &+ 0.2612 \times \text{SLLTI value for PCT A} \\ &+ 0.2368 \times \text{SMR}<65 \text{ value for PCT A} \end{aligned}$$

The result for each PCT is multiplied by the crude population for that PCT to give the weighted population in the same manner as the other additional need adjustments.

## DFLE FORMULA (FORMERLY THE HEALTH INEQUALITIES FORMULA)

185. The DFLE formula is applied in the same way as described in the HCHS component and given a weighting of 10%.

## GEOGRAPHICAL COST

186. The MFF consists of the following indices:

- (a) GP pay
- (b) practice staff employment costs
- (c) land
- (d) buildings
- (e) other.

187. A common index of 1.00 is given to (e). The separate MFFs are described below.

### GP pay MFF

188. The GP pay MFF is intended to compensate for the fact that PCTs with higher deprivation face greater GP recruitment and retention difficulties. Evidence suggests that one of the main factors which influences where GPs choose to practice is the level of deprivation (and associated factors) of the area. Research by the National Primary Care Research and Development Centre (NPCRDC) suggested that GPs valued the disamenity of living and working in a deprived area at £4,200 (approximately 7.5% of the then average salary). The GP pay MFF is based on deprivation as measured by the Index of Deprivation 2007 (ID2007) for each PCT. The ID2007 score is scaled so that there is a 7.5% difference between the upper decile most deprived PCT and the lower decile most deprived PCT. The result is indexed.

### Practice staff MFF

189. The practice staff MFF is the same as the HCHS non-medical component, except that PCT values unadjusted by the PPM (ie the host MFFs) are used because primary medical services are provided locally.

### Land MFF

190. The land MFF uses the average small site (up to five houses) value in each LAD area supplied by the Valuation Office Agency (VOA) and mapped to PCTs. The index is calculated as the ratio of the average small site in an area to the national average value. An average of the twice-yearly valuations in January and July between 2007 and 2009 is used.

### Buildings MFF

191. The buildings MFF is the same as the HCHS component, except that PCT values unadjusted by the PPM (ie the host MFFs) are used because primary medical services are provided locally.

### Overall MFF

192. These separate MFFs are combined into an overall MFF using weights derived from Inland Revenue data published in the GP Earnings and Expenses Enquiry 2007-08<sup>18</sup> which reports national average expenditure on GP income and different types of expenses. The data do not provide a split of land and buildings. A judgement was made to split these in the ratio of 5 to 1. The weights are shown in Table 14.

**Table 14: Primary medical services component MFF weights**

	%
GP Pay	42.1
Practice staff	34.2
Land	1.3
Buildings	6.4
Other	16.1
<b>Total</b>	<b>100.0</b>

<sup>18</sup> The GP Earnings and Expenses Enquiry 2007-08 is available at <http://www.ic.nhs.uk/statistics-and-data-collections/primary-care/general-practice/gp-earnings-and-expenses-final-report-2007-08>

## PRIMARY MEDICAL SERVICES WEIGHTED POPULATION

193. An age-gender index, an additional need index (including the DFLE formula) and an MFF index are created. To calculate the primary medical services weighted population, the crude populations of each PCT are simultaneously multiplied by these indices and then normalised so that they sum to the total crude population.



# Section 6: Calculation of Targets and Distances From Targets

## WEIGHTED CAPITATION TARGETS

194. The weighted populations calculated separately for the HCHS, prescribing and primary medical services components are combined using national expenditure weights to create a single weighted population for each PCT. The weights are based on the latest available year and are shown in Table 15.

**Table 15: Component weights**

	%
HCHS	78.6
Prescribing	11.1
Primary medical services	10.3

195. The weighted capitation formula is used to calculate PCTs' relative weighted population shares. It does not determine a monetary value by itself. Each PCT's monetary target allocations are determined by applying the relative weighted population shares to the total resources available.

## DISTANCES FROM TARGETS

196. Targets are subtracted from baselines to produce DFTs for each PCT. DFTs inform the distribution of growth in allocations.
197. The tables at Appendix 5 show simplified worked examples for four PCTs of the calculation of targets and DFTs. For the actual calculation of PCT targets for 2011-12, see the 2011-12 PCT Revenue Allocations Exposition Book.



# List of Abbreviations

ACRA	Advisory Committee on Resource Allocation
ADS	Attribution Data Set
AIDS	Acquired Immuno-Deficiency Syndrome
AREA	Allocation of Resources to English Areas
ASHE	Annual Survey of Hours and Earnings
ASTRO-PU	Age, Sex, Temporary Resident Originated Prescribing Unit
BCIS	Building Cost Information Service
CAMS	Child and adolescent mental health services
CARAN	Combining Age Related and Additional Needs
DCLG	Department for Communities and Local Government
DFLE	Disability Free Life Expectancy
DFT	Distance from target
DHAs	District Health Authorities
DLA	Disability Living Allowance
DMS	Defence Medical Services
EACA	Emergency Ambulance Cost Adjustment
ELDA	English Language Difficulties Adjustment
ERIC	Estates Return Information Collection
GHS	General Household Survey
GLM	General Labour Market
GMS	General Medical Service
GMSCL	General Medical Services Cash Limited
GMSNCL	General Medical Services Non-Cash Limited
GP	General Practitioner
GPRD	General Practice Research Database
HA	Health Authority
HCHS	Hospital and Community Health Services
HERU	Health Economics Research Unit
HES	Hospital Episode Statistics
HIA	Health Inequalities Adjustment
HIV	Human Immuno-Deficiency Virus
HPA	Health Protection Agency
HSE	Health Survey for England
ID2004	Index of Deprivation 2004
ID2007	Index of Deprivation 2007
LAD	Local Authority District
LFS	Labour Force Survey
LISI	Low Income Scheme Index
LLTI	Limiting Long Term Illness
LSOA	Lower Layer Super Output Area

## Resource Allocation: Weighted Capitation Formula

M&D	Medical and dental
MFF	Market Forces Factor
MHA	Mallender Hancock Associates
MHMDS	Mental Health Minimum Data Set
MSGP	Morbidity Statistics from General Practice
MSOA	Middle Layer Super Output Area
MYEs	Mid-year (population) estimates
NHAIS	National Health Applications and Infrastructure Services
NPCRDC	National Primary Care Research and Development Centre
ONS	Office for National Statistics
QOF	Quality and Outcomes Framework
PbR	Payment by Results
PCG	Primary Care Group
PCT	Primary Care Trust
PPM	Purchaser Provider Matrix
PSU	Prescribing Support Unit
RAG	Resource Allocation Group
RAMP	Resource Allocation for Mental Health and Prescribing (Project)
RARP	Resource Allocation Research Paper
RAWP	Resource Allocation Working Party
RHAs	Regional Health Authorities
SCA	Specific Cost Approach
SLLTI	Standardised Limiting Long Term Illness Ratio
SMR	Standardised Mortality Ratio
SNPPs	Subnational population projections
SOPHID	Survey of Prevalent HIV Infections that are Diagnosed
SSWD	Standardised Spatial Wage Differential
TAG	Technical Advisory Group
US	United States
VOA	Valuation Office Agency
YLL	Years of life lost

# Glossary

## **Additional needs**

Health care needs over and above those relating to age and gender.

## **Attribution Dataset (ADS)**

A dataset extracted from the 87 NHAIS systems that records the home postcode of people registered with GP practices.

## **Coefficient**

Coefficients show the quantified relationship between the dependent and independent variables (holding all other variables constant) and are normally obtained by statistical analysis of historical data on the variables.

## **Counter-intuitive signs**

Refers to variables that have coefficients with unexpected signs in a regression model. For example, areas with more employment deprivation might be expected to have higher utilisation of health care services all else being equal, when they are found to have lower use. These may be due to unmet needs but may be due to other factors as well.

## **Dependent variable**

The variable that is being modelled. Its value is known, but an explanation of why it is high in some circumstances and low in others is sought.

## **Disability Free Live Expectancy (DFLE)**

The number of years from birth a person is expected to live which are free from limiting long-term illness and disability.

## **Disability living allowance (DLA)**

A non means-tested benefit for those with a severe physical or mental illness or disability and who are under age 65. It is payable to both children and adults.

## **Epidemiological approach**

An approach to allocating health resources based on the assumption that health care needs in an area are proportional to the number of cases of disease in an area.

## Resource Allocation: Weighted Capitation Formula

### Explanatory variable

The variables which are used to try and explain the values of the dependent variable. Also known as independent variables.

### Exponential distance decay function

A function used to smooth Standardised Spatial Wage Differentials (SSWDs) so that SSWDs of areas in close proximity to the base area receive greater weight than areas further away.

### Income support

A means tested benefit for people under 60 on a low income who are not required to be available for work.

### Indices of Deprivation

The DCLG Index of Multiple Deprivation combines a number of indicators, chosen to cover a range of economic, social and housing issues, into a single deprivation score for each small area in England.

These Indices of Deprivation contain several domains of deprivation, and each domain contains a number of indicators.

The current formula uses Indices of Deprivation for 2004 and 2007 (ID2004 and ID2007).

### Limiting long-term illness

The numbers of people in households with a limiting long-term illness are based on answers to the question from the 2001 Census "Do you have any long-term illness, health problem or disability which limits your daily activities or the work you can do?" In the modelling of need, the number of people with a limiting long-term illness was expressed as a proportion of the total number of people for each local area.

### Low income scheme index (LISI)

LISI is derived from practice prescribing data. The LISI score for a practice is defined as the percentage of costs of dispensed prescriptions that are exempt from prescription charges on the grounds of low income, and that are not exempt under some other criterion.

### Needs indicator

Variables representing individuals need for health care services.

## Normalisation

The process whereby figures for, eg, PCTs are scaled by the same proportion so that they sum to a given total. For example when weighted populations are scaled back so they sum to the crude population for England. The normalisation factor, ie the scaling factor in this case is the population of England divided by the sum of weighted PCT populations. Relative shares are unaffected by this process.

## One stage approach

A variant of the utilisation approach that accounts for age related needs and additional needs in a single stage estimation methodology.

## Regression analysis

Regression analysis is a statistical technique used to explain the dependence of one variable - called the dependent variable (Y), on one or more other variables - called variously the independent, the explanatory or control variables (X). In a very simple two variable model (one dependent and one explanatory variable) the data can be plotted as a scatter of points on a two dimensional graph. Regression analysis involves putting a line through these points. The degree of scatter around the line measures what is called goodness of fit. The objective is to minimise this degree of scatter.

The slope of a regression line indicates the nature of the relationship between the two variables - positive, ie an upward sloping line, or negative, ie a downward sloping line. However, the real power of regression analysis lies in its ability to quantify the separate effect of each independent variable on the dependent variable. The quantified effect of each variable is also called its coefficient.

## Spearhead areas

The Spearhead areas are the 70 LADs, and the 62 PCTs which map to them, which are in the bottom fifth nationally for three or more of the following five health and deprivation indicators:

- male life expectancy at birth
- female life expectancy at birth
- cancer mortality rate in under 75s
- cardio vascular disease mortality rate in under 75s
- Index of Multiple Deprivation 2004

### Standardisation

The aim of standardisation is to allow a more precise comparison of the measure of interest between geographical areas by eliminating the effect of differences between the age and gender structures of populations. There are two main methods of achieving this: direct standardisation and indirect standardisation (eg SMR).

### Standardised birth ratio

The ratio of the number of births in an area to the expected number of births in the area, where the expected number of births is calculated by multiplying the number of women in each age group in the area by national age-specific fertility rates.

### Standardised mortality ratio (SMR)

A measure of mortality rates which uses indirect standardisation. The SMR reflects the number of deaths that would have occurred if the area had the same death rates as for England. The local age structure is applied to the national age-specific death rates, giving an expected number of deaths for each age group. The SMR is the observed number of deaths in the local area divided by the expected number of deaths in the area.

### Standardised spatial wage differential (SSWD)

SSWDs represent difference in pay rates across the country that are due to location only. The underpinning regression analysis attempts to control or standardise for factors such as age, gender, occupation and industry. Area wage differentials which remain after all measurable differences in worker quality and job attributes have been controlled for, are taken to reflect pay differences solely due to location.

### Sterilisation

A method in which variables that ought not to affect the allocation of resources are removed so that they do not affect allocations either directly or indirectly via their relationship with other variables. Typically this is achieved by setting their values to the national average for each PCT.

### Supply variable

Variables that measure the availability of, access to, and or costs of using health care services in an area.



## Transformation

The values of variables in regression analysis are often transformed to allow the relative impact of the variables on the dependent variable to be interpreted solely on the basis of the values of the coefficients.

In the CARAN Report, the need indicators are transformed by subtracting the population mean value from the raw value and then dividing the difference by the population standard deviation. These are called z-scores.

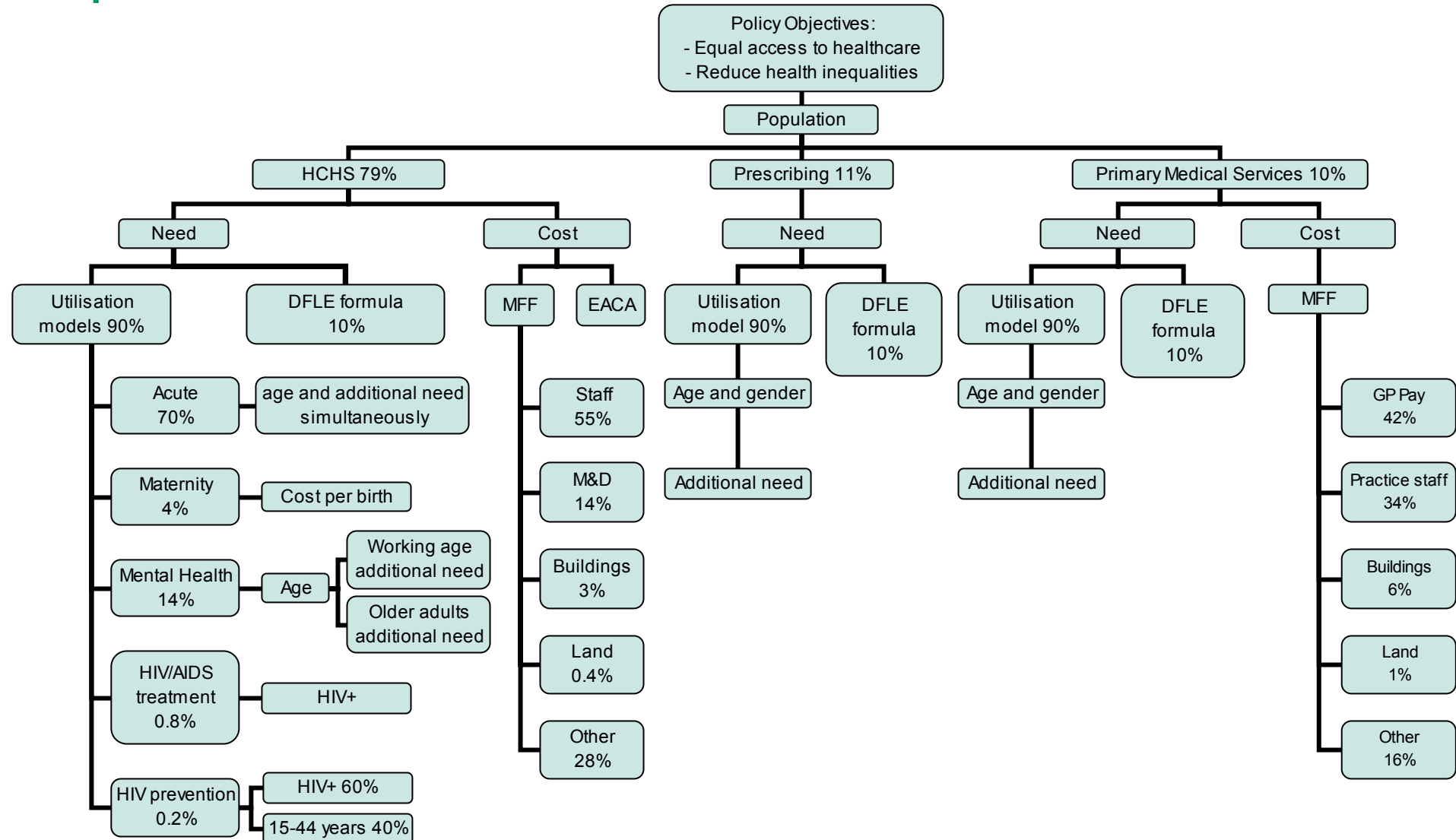
## Two stage approach

A variant of the utilisation approach that accounts for age-gender related need and additional need in two separate stages.

## z-score

A method of transformation used in the CARAN Report. They allow the straightforward comparison of the values of coefficients of the independent variables, when we would otherwise have to take account of the different scales on which the independent variables are measured.

# Appendix 1: Schematic Diagram of Weighted Capitation Formula



# Appendix 2: Resource Allocation Research Papers

Number	Title	Date of publication	Authors
RARP 1	Sharing Resources for Health in England Report of the Resource Allocation Working Party	1976	DHSS
RARP 2	Report of the Advisory Group on Resource Allocation	1980	DHSS
RARP 3	Geographic Variations in the Cost of Health Service Inputs Government Economic Service Working Paper No.35	October 1980	DHSS
RARP 4	Review of the Resource Allocation Working Party Formula (Interim report)	1986	DHSS/NHS Management Board
RARP 5	Review of the Resource Allocation Working Party Formula (Final report)	1988	DHSS/NHS Management Board
RARP 6	National Average Cost Weights by Specialty Group	June 1993	East Cheshire Statistical Analysis Consultancy
RARP 7	A Formula for Distributing NHS Revenues Based on Small Area Use of Hospital Beds	September 1994	University of York
RARP 8	The Resource Allocation Consequences of the New NHS Needs Formula	May 1995	University of York
RARP 9	Report of the Prescribing Allocations Group	November 1995	NHS Executive
RARP 10	A Literature Review of Local Variation in the Needs of People with a Learning Disability for Health Service Input	July 1996	Norah Fry Research Centre University of Bristol
RARP 11	Interim Needs Indicators for Community Health Services	September 1996	Universities of Kent and Plymouth
RARP 12	Labour Market Forces and NHS Provider Costs Final Report	September 1996	University of Warwick
RARP 13	No Need to Weight Community Health Programmes for Resource Allocation?	1996	University of York

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Number	Title	Date of publication	Authors
RARP 14	Study of Costs of Providing Health Services In Rural Areas Progress Report to Resource Allocation Group - Volumes 1 and 2	June and September 1997	MHA/ Operational Research in Health Ltd
RARP 15	Measuring Need for People with Learning Disabilities - Report for the Department of Health Resource Allocation Group	September 1997	Nuffield Institute for Health (University of Leeds)
RARP 16	The Unavoidable Costs of Ethnicity A Review for the NHS Executive	January 1998	University of Warwick
RARP 17	Equity of Access to Healthcare	March 1998	University of York
RARP 18	National Average Specialty Treatment and Hotel Costs	March 1998	MHA
RARP 19	The Role of Private Healthcare in the York Indices of Healthcare Needs	April 1998	University of York
RARP 20	Assessment of the Costs to the NHS Arising from the Need for Interpreter, Advocacy and Translation (IAT) services	July 1998	University of Warwick
RARP 21	Towards Locally Based Resource Allocation in the NHS	August 1998	University of York
RARP 22	Derivation of a Needs Based Capitation Formula for Allocating Prescribing Budgets	January 1999	University of York and Prescribing Support Unit
RARP 23	Review of Drugs Misuse Allocation Formula	September 2000	University of York
RARP 24	A GMS Needs Measure Based on the GHS	May 2001	University of York
RARP 25	Spatial Variations in Labour Costs - 2001 Review of the Staff Market Forces Factor	March 2002	University of Warwick
RARP 26	Allocation of Resources to English Areas	December 2002	Sutton et al.
RARP 27	GMS Contract: Workload Formula	October 2008	University of York
RARP 28	An Analysis of the Factors Predicting GP Consultations: a Small Area Analysis Using Health Survey for England Data	October 2008	Morris et al.

## Appendix 2: Resource Allocation Research Papers

Number	Title	Date of publication	Authors
RARP 29	Review of Population Base for PCT Allocation Post 2008	October 2008	Prescribing Support Unit
RARP 30	Combining Age Related and Additional Needs (CARAN) Report	October 2008	Morris et al.
RARP 31	Review of Specific Cost Approach to Market Forces Factor	October 2008	Crystal Blue Consulting Ltd
RARP 32	Review of the Market Forces Factor Following the Introduction of Payment by Results (2005): Exploring the General Labour Market Method	October 2008	Health Economics Research Unit
RARP 33	Review of the Weighted Capitation Formula	October 2008	Gwyn Bevan
RARP 34a	The Staff Market Forces Factor component of the resource allocation weighted capitation formula: new estimates	May 2010	Health Economics Research Unit
RARP 34b	The Staff Market Forces Factor component of the resource allocation weighted capitation formula: refinements to method	November 2010	Health Economics Research Unit
RARP 35	Report of the Resource Allocation for Mental health and Prescribing (RAMP) project	December 2010	Sutton et al
RARP 36	Research on the health inequalities elements of the NHS weighted capitation formula	October 2010	Morris et al

# Appendix 3: Resource Allocation Working Papers

Number	Title
RAWP 1	History of Staff Market Forces Factor
RAWP 2	Population Data For Allocations
RAWP 3	The Exeter Data Set and Attribution Part 1 - Use of the Exeter Practice Registration Data Base Part 2 - Exeter Attribution Project - Progress Report Part 3 - Attribution Accuracy For GP Practices and PCGs
RAWP 4	A Brief History of Resource Allocation in the NHS 1948-98
RAWP 5	A History of GP Distribution
RAWP 6	The Years of Life Lost Index and Health Inequalities Adjustment
RAWP 7	The Staff MFF

# Appendix 4: Variables in the Models

Variable	Description
<b>HCHS acute (RARP 30, p143, Table 14.5)</b>	
deathrate	Death rates 2001-2005 by 18 5-year age groups ONS
idincch	Income deprivation affecting children ID2004
stnoquals	Standardised proportion aged 16-74 with no qualifications 2001 Census
pr_lb	Proportion of births that are low birth weight ONS 2001-05
dlav2	Proportion under 16 claiming Disability Living Allowance 2005
educv1	Percentage of young people not staying in education ID2004
liti	Standardised limiting long-term illness 2001 Census
dlav1	Proportion claiming Disability Living Allowance 2005
newdv1	Proportion claiming New Deal for Young People 2004
ibsdav1	Proportion claiming Incapacity Benefit/Severe Disability Allowance 2005
pencrv1	Proportion aged over 60 claiming Pension Credit 2005
dlav8	Proportion over 60 claiming Disability Living Allowance 2005
<b>HCHS maternity (RARP 30, p184, Table 17.5, Model 2)</b>	
pr_lbwm	Proportion of births that are low birth weight 2001-05
housprv2	Mean house price for all dwellings 2005
<b>HCHS mental health (RARP 35, tables 2.12 and 2.13)</b>	
ibsda_mental_rate	IB/SDA with a mental health diagnosis (2008 DWP data)
smrmind0108	SMR where a mental illness excluding dementia is indicated (ONS data for 2001-08)
black	Proportion Black (2001 Population Census)
smrmi0108	SMR where a mental illness is indicated (ONS data for 2001-08)
pc_single_rate	Population aged 60+ that are single pension credit claimants (2008 DWP data)

## Resource Allocation: Weighted Capitation Formula

Variable	Description
<b>Prescribing (RARP 35, Table 3.2, Model 4)</b>	
lisi2008	Low income scheme index 2009
prop85plus	The number aged over 85 years as a proportion of all those age over 75 years (2008)
dla_70plus_rate_att2008	The number aged over 70 claiming disability living allowance as a proportion of the total population aged over 70 years (2008)
smrads	Standardised mortality ratio, all ages (2004-08)
firtrate0408	Generalised fertility rate (Data for 2004-08)
chd_stqof	Age standardised QOF Coronary Heart Disease prevalence (2007/8)
dm_stqof	Age standardise QOF Diabetes prevalence (2007/8)
bp_stqof	Age standardised QOF Hypertension prevalence (2007/8)
<b>Primary medical services (RARP 28, p18, Table 3.10, Model 13.1)</b>	
liti	Standardised limiting long-term illness 2001 Census
smr64	Standardised Mortality Ratio 0-64 year olds ONS 2004-06



# Appendix 5: Worked Example of PCT Target Calculations

## HCHS COMPONENT

**Table: HCHS crude population**

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	Total
	Sum A to R																		
PCT A	12	10	11	15	20	17	12	13	13	14	13	11	10	8	8	6	4	3	200
PCT B	24	19	18	20	27	26	19	17	16	14	11	9	7	7	6	5	3	2	250
PCT C	17	12	10	10	20	34	31	24	21	16	12	10	9	7	6	5	3	3	250
PCT D	15	15	17	20	17	15	13	18	21	21	20	20	23	18	15	12	10	10	300
Total	68	56	56	65	84	92	75	72	71	65	56	50	49	40	35	28	20	18	1,000

**Table 16: HCHS acute need variables and coefficients by age group**

	A	B	C	D	E	F	G	H	I	J	K	L	M
	0-4	0-4	0-4	0-4	5-9	5-9	5-9	10-14	10-14	10-14	15-19	15-19	15-19
	202.5	13.7	9.5	5.4	541.5	11.9	10.4	494.5	13.0	6.2	465.7	13.7	12.1
	Death rates 2001-2005	Income deprivation affecting children ID2004	Standardised proportion aged 16-74 with no qualifications 2001 Census	Proportion of births that are low birth weight 2001 to 2005	Death rates 2001-2005	Standardised proportion aged 16-74 with no qualifications 2001 Census	Income deprivation affecting children ID2004	Death rates 2001-2005	Proportion under 16 claiming Disability Living Allowance 2005	Standardised proportion aged 16-74 with no qualifications 2001 Census	Death rates 2001-2005	Percentage of young people not staying in education ID2004	Standardised limiting long-term illness 2001 Census
	deathrate	idincch	stnoquals	pr-lbw	deathrate	stnoquals	idincch	deathrate	dlav2	stnoquals	deathrate	educv1	llti
PCT A	-0.31	1.73	1.11	0.56	-0.36	1.06	1.61	-0.36	0.75	1.02	-0.35	0.42	1.76
PCT B	-0.26	1.52	2.04	1.76	-0.36	2.05	1.48	-0.36	0.65	1.97	-0.35	-0.55	1.42
PCT C	-0.30	1.86	0.14	0.35	-0.36	0.18	1.89	-0.36	0.27	0.21	-0.35	-0.06	0.99
PCT D	-0.33	-0.31	-0.38	-0.43	-0.36	-0.42	-0.35	-0.36	-0.06	-0.43	-0.35	-0.10	-0.40

Resource Allocation: Weighted Capitation Formula

Table 2 continued

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
	20-24	20-24	20-24	25-29	25-29	25-29	25-29	30-34	30-34	30-34	30-34	35-39	35-39	35-39
	883.1	20.6	14.5	209.5	23.6	16.3	8.5	316.5	21.5	15.9	6.5	344.9	24.5	23.9
	Death rates 2001-2005	Percentage of young people not staying in education ID2004	Standardised limiting long-term illness 2001 Census	Death rates 2001-2005	Standardised proportion aged 16-74 with no qualifications 2001 Census	Proportion claiming Disability Living Allowance 2005	Proportion claiming New Deal for Young People 2004	Death rates 2001-2005	Standardised proportion aged 16-74 with no qualifications 2001 Census	Proportion claiming Disability Living Allowance 2005	Proportion claiming New Deal for Young People 2004	Death rates 2001-2005	Proportion claiming Incapacity Benefit/Severe Disability Allowance 2005	Standardised limiting long-term illness 2001 Census
	deathrate	educv1	liti	deathrate	stnoquals	dlav1	newdv1	deathrate	stnoquals	dlav1	newdv1	deathrate	ibsdav1	liti
PCT A	-0.35	0.49	1.88	-0.33	0.97	2.26	0.85	-0.32	0.99	2.33	0.93	-0.31	1.92	1.84
PCT B	-0.35	-0.43	1.48	-0.34	1.87	0.53	1.48	-0.33	1.90	0.55	1.51	-0.32	0.67	1.41
PCT C	-0.35	-0.05	0.97	-0.35	0.08	0.34	1.30	-0.33	0.05	0.33	1.30	-0.31	0.59	0.90
PCT D	-0.35	-0.27	-0.34	-0.34	-0.39	-0.23	-0.48	-0.33	-0.38	-0.24	-0.47	-0.33	-0.16	-0.37

Table 2 continued

	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
	35-39	40-44	40-44	40-44	40-44	45-49	45-49	45-49	45-49	50-54	50-54	50-54	50-54
	7.1	418.0	27.6	22.4	15.7	292.2	32.3	27.4	18.7	285.6	32.8	31.0	25.1
	Percentage of young people not staying in education ID2004	Death rates 2001-2005	Standardised limiting long-term illness 2001 Census	Standardised proportion aged 16-74 with no qualifications 2001 Census	Proportion claiming Incapacity Benefit/Severe Disability Allowance 2005	Death rates 2001-2005	Standardised limiting long-term illness 2001 Census	Standardised proportion aged 16-74 with no qualifications 2001 Census	Proportion aged over 60 claiming Pension Credit 2005	Death rates 2001-2005	Standardised limiting long-term illness 2001 Census	Standardised proportion aged 16-74 with no qualifications 2001 Census	Proportion aged over 60 claiming Pension Credit 2005
	educv1	deathrate	liti	stnoquals	ibsdav1	deathrate	liti	stnoquals	pencrv1	deathrate	liti	stnoquals	pencrv1
PCT A	0.51	-0.27	1.77	0.95	1.88	-0.24	1.70	0.93	1.32	-0.15	1.67	0.90	1.28
PCT B	-0.57	-0.28	1.34	1.77	0.64	-0.22	1.28	1.69	2.06	-0.15	1.27	1.70	2.05
PCT C	-0.11	-0.29	0.92	0.08	0.60	-0.22	0.93	0.09	1.48	-0.15	0.92	0.08	1.48
PCT D	0.01	-0.32	-0.40	-0.43	-0.19	-0.29	-0.41	-0.45	-0.48	-0.24	-0.42	-0.47	-0.50

Table 2 continued

	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA
	55-59	55-59	55-59	55-59	60-64	60-64	60-64	60-64	65-69	65-69	65-69	70-74	70-74
	294.1	42.3	33.3	23.9	173.5	48.1	33.5	20.0	211.9	65.5	36.3	180.2	62.1
	Death rates 2001-2005	Standardised limiting long-term illness 2001 Census	Proportion aged over 60 claiming Pension Credit 2005	Standardised proportion aged 16-74 with no qualifications 2001 Census	Death rates 2001-2005	Proportion aged over 60 claiming Pension Credit 2005	Standardised limiting long-term illness 2001 Census	Standardised proportion aged 16-74 with no qualifications 2001 Census	Death rates 2001-2005	Proportion aged over 60 claiming Pension Credit 2005	Proportion over 60 claiming Disability Living Allowance 2005	Death rates 2001-2005	Proportion over 60 claiming Disability Living Allowance 2005
	deathrate	liti	pencrv1	stnoquals	deathrate	pencrv1	liti	stnoquals	deathrate	pencrv1	dlav8	deathrate	dlav8
PCT A	-0.04	1.67	1.29	0.89	0.17	1.26	1.65	0.88	0.48	1.26	2.56	0.98	2.56
PCT B	-0.01	1.25	2.03	1.68	0.15	1.90	1.17	1.58	0.43	1.90	1.01	0.91	1.08
PCT C	-0.08	0.91	1.46	0.07	0.14	1.46	0.90	0.07	0.42	1.46	0.76	0.88	0.77
PCT D	-0.19	-0.44	-0.52	-0.48	-0.09	-0.55	-0.45	-0.50	0.09	-0.57	-0.75	0.47	-0.76

Table 2 continued

	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK
	70-74	75-79	75-79	75-79	80-84	80-84	80-84	85+	85+	85+
	57.5	148.8	44.5	38.2	117.5	33.3	28.4	258.2	124.1	21.8
	Proportion aged over 60 claiming Pension Credit 2005	Death rates 2001-2005	Proportion aged over 60 claiming Pension Credit 2005	Standardised proportion aged 16-74 with no qualifications 2001 Census	Death rates 2001-2005	Proportion aged over 60 claiming Pension Credit 2005	Standardised proportion aged 16-74 with no qualifications 2001 Census	Proportion over 60 claiming Disability Living Allowance 2005	Proportion aged over 60 claiming Pension Credit 2005	Death rates 2001-2005
	pencrv1	deathrate	pencrv1	stnoquals	deathrate	pencrv1	stnoquals	dlav8	pencrv1	deathrate
PCT A	1.25	1.82	1.21	0.87	3.01	1.16	0.82	2.35	1.18	6.68
PCT B	2.02	1.60	2.07	1.73	2.35	2.04	1.68	1.02	1.93	5.55
PCT C	1.47	1.58	1.48	0.11	2.44	1.50	0.15	0.76	1.49	5.74
PCT D	-0.57	1.06	-0.56	-0.50	1.98	-0.55	-0.50	-0.76	-0.52	5.67

Resource Allocation: Weighted Capitation Formula

Table 17: HCHS acute need constant terms

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Age band	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
Constant	317.6	401.5	378.9	379.6	536.0	328.5	378.3	413.8	476.9	492.4	554.0	658.0	818.4	985.2	1,211.2	1,423.9	1,616.5	2,705.0

Table 18: Calculate HCHS acute weighted population

	A	B	C	D	E	F	G
	average cost per person						
	0-4	5-9	10-14	15-19	20-24	25-29	30-34
	317.6 + 202.5 deathrate + 13.7 idincch + 9.5 stnoquals + 5.4 pr_lbw	401.5 + 541.5 deathrate + 10.4 idincch + 11.9 stnoquals	378.9 + 494.5 deathrate + 6.2 stnoquals + 13.0 dlav2	379.6 + 465.7 deathrate + 13.7 educv1 + 12.1 llti	536.0 + 883.1 deathrate + 20.6 educv1 + 14.5 llti	328.5 + 209.5 deathrate + 23.6 stnoquals + 16.3 dlav1 + 8.5 newdv1	378.3 + 316.5 deathrate + 21.5 stnoquals + 15.9 dlav1 + 6.5 newdv1
PCT A	292	236	218	244	263	325	341
PCT B	315	248	222	225	244	323	333
PCT C	286	228	208	228	244	275	287
PCT D	241	198	197	210	218	240	258
Total							

Table 4 continued

	H	I	J	K	L	M	N
	average cost per person						
	35-39	40-44	45-49	50-54	55-59	60-64	65-69
	413.8 + 344.9 deathrate + 7.1 educv1 + 23.9 llti + 24.5 ibsdav1	476.9 + 418.0 deathrate + 22.4 stnoquals + 27.6 llti + 15.7 ibsdav1	492.4 + 292.2 deathrate + 27.4 stnoquals + 32.3 llti + 18.7 pencrv1	554.0 + 285.6 deathrate + 31.0 stnoquals + 32.8 llti + 25.1 pencrv1	658.0 + 294.1 deathrate + 23.9 stnoquals + 42.3 llti + 33.3 pencrv1	818.4 + 173.5 deathrate + 20.0 stnoquals + 33.5 llti + 48.1 pencrv1	985.2 + 211.9 deathrate + 65.5 pencrv1 + 36.3 dlav8
PCT A	403	463	528	627	779	981	1,263
PCT B	351	446	555	657	817	1,007	1,238
PCT C	341	393	488	581	724	945	1,198
PCT D	286	321	374	445	554	752	941
Total							

Table 4 continued

	O	P	Q	R	S	T
	average cost per person				Total cost	Acute weighted population
	70-74	75-79	80-84	85+		
	1211.2 + 180.2 deathrate + 57.5 pencrv1 + 62.1 dlav8	1423.9 + 148.8 deathrate + 38.2 stnoquals + 44.5 pencrv1	1616.5 + 117.5 deathrate + 28.4 stnoquals + 33.3 pencrv1	2705.0 + 21.8 deathrate + 124.1 pencrv1 + 258.2 dlav8	Sum product of Table 1 cols A to R and Table 4 cols A to R	S normalised to Table 1 col S
PCT A	1,619	1,781	2,032	3,603	124,640	226
PCT B	1,559	1,820	2,008	3,330	124,374	225
PCT C	1,502	1,729	1,957	3,211	123,552	224
PCT D	1,215	1,538	1,816	2,569	179,264	325
Total					551,830	1,000

Resource Allocation: Weighted Capitation Formula

Table 19: Calculate HCHS maternity need weighted population

	A	B	C	D	E	F
		model coefficients		constant		
	ONS Birth registrations 2008	24.7	-96.1	2,308.8		
		Low birth weight births	Mean house price	Average cost of birth	Total cost of births	Maternity weighted population
		pr-lbwm	housprv2	2308.8 + 24.7 pr_lbwm -96.1 housprv2	A * D	E normalised to Table 1 col S
PCT A	10	0.50	-0.81	2,399	23,987	131
PCT B	20	1.73	-0.69	2,418	48,359	264
PCT C	30	0.32	1.44	2,178	65,354	357
PCT D	20	-0.46	0.24	2,274	45,481	248
Total	80				183,181	1,000

Table 20: HCHS mental health age weights

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Under 16 estimated age weights <sup>1</sup>			RAMP mental health age cost-weights													
Age band	0-4	5-15	16-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
weight	18	8263	41.7	81.4	105.7	111.2	114.6	109.5	104.3	92.0	83.8	78.5	86.3	107.2	145.3	176.4	167.1

<sup>1</sup> Under 16 weights have been estimated from 2008-09 HES reference cost activity and are not on the same basis as the RAMP age cost-weights

Table 21: HCHS mental health age band populations

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
	0-4	5-15	16-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	Total	Under 16	16-64	65+
	Table 1 Col A	Table 1 Cols B+C+ (D*1/5)	Table 1 Col D * 4/5	Table 1 Col E	Table 1 Col F	Table 1 Col G	Table 1 Col H	Table 1 Col I	Table 1 Col J	Table 1 Col K	Table 1 Col L	Table 1 Col M	Table 1 Col N	Table 1 Col O	Table 1 Col P	Table 1 Col Q	Table 1 Col R	sum A to Q	sum A to B	sum C to L	sum M to Q
PCT A	12	24	12	20	17	12	13	13	14	13	11	10	8	8	6	4	3	200	36	135	29
PCT B	24	41	16	27	26	19	17	16	14	11	9	7	7	6	5	3	2	250	65	162	23
PCT C	17	24	8	20	34	31	24	21	16	12	10	9	7	6	5	3	3	250	41	185	24
PCT D	15	36	16	17	15	13	18	21	21	20	20	23	18	15	12	10	10	300	51	184	65
Total	68	125	52	84	92	75	72	71	65	56	50	49	40	35	28	20	18	1,000	193	666	141

Table 22: Calculate HCHS mental health age indices

	A	B	C	D	E	F	G	H	I
	Under 16			Working age (16-64)			Older adults (65+)		
	Under 16 pop * under 16 age cost-weights	Under 16 pop * under 16 age cost-weights normalised	Under 16 age cost index	Working age pop * Working age age cost-weights	Working age pop * Working age age cost-weights normalised	Working age age cost index	Older adults pop * Older adults age cost-weights	Older adults pop * Older adults age cost-weights normalised	Older adults age cost index
	Sum product Table 7 cols A and B and Table 6 Cols A and B	A normalised to Table 7 Col S	B / Table 7 Col S	Sum product Table 7 Cols C to L and Table 6 Cols C to L	D normalised to Table 7 Col T	E / Table 7 Col T	Sum product Table 7 Cols M to Q and Table 6 Cols M to Q	G normalised to Table 7 Col U	H / Table 7 Col U
PCT A	198,521	37	1.03	12,538	132	0.98	3,627	29	0.99
PCT B	339,204	63	0.97	15,204	161	0.99	2,837	22	0.98
PCT C	198,611	37	0.90	18,373	194	1.05	3,004	24	0.99
PCT D	297,728	56	1.09	16,958	179	0.97	8,340	66	1.02
Total	1,034,065	193	1.00	63,073	666	1.00	17,809	141	1.00

Resource Allocation: Weighted Capitation Formula

**Table 23: Calculate HCHS mental health additional need indices**

	A	B	C	D	E	F	G
	Working age additional need model			Older adults additional need model			
	model coefficients			constant	model coefficients		constant
	36.03	0.07	2.16	0.09	0.54	1.25	0.27
	IB/SDA with mental health diagnosis	SMR MI (excl dementia)	Proportion Black	Additional need index <65s	SMR MI	Population aged 60+ that are single pension credit claimants	Additional need index > 65s
	ibstda_mental_rate	smrmind0108	black	0.09 + 36.03 ibstda_mental_rate+ 0.07 smrmind0108+ 2.16 black	smrmi0108	pc_single_rate	0.27 + 0.54 smrmi0108+ 1.25 pc_single_rate
PCT A	0.05	1.31	0.01	1.91	1.22	0.30	1.31
PCT B	0.03	1.49	0.12	1.62	1.19	0.36	1.38
PCT C	0.04	1.11	0.11	1.83	1.09	0.34	1.29
PCT D	0.02	0.80	0.00	0.80	0.84	0.12	0.88

**Table 24: Calculate HCHS mental health weighted populations**

	A	B	C	D	E	F	G	H	I	J
	Under 16				Working age (16-64)					
	Additional need	Additional needs normalised to under 16 popn	additional need index	weighted population	weighted population normalised	Additional need	Additional needs normalised to 16-64 popn	additional need index	weighted population	weighted population normalised
	Table 7 Col S * Table 9 Col D	A normalised to Table 7 Col S	B / Table 7 Col S	C * Table 7 Col S * Table 8 Col C	D normalised to Table 7 Col S	Table 7 Col T * Table 9 Col D	F normalised to Table 7 Col T	G / Table 7 Col T	H * Table 7 Col T * Table 8 Col F	I normalised to Table 7 Col T
PCT A	69	46	1.27	47	48	257	170	1.26	167	166
PCT B	106	70	1.08	68	69	263	174	1.08	173	172
PCT C	75	50	1.22	45	46	338	224	1.21	235	234
PCT D	41	27	0.53	30	30	147	97	0.53	95	94
Total	290	193	1.00	190	193	1,006	666	1.00	669	666



Table 10 continued

	K	L	M	N	O	P	Q	R	S
<b>Older Adults</b>	Mental health age component weights								
				Under 16s			16-64	65+	
			7.1%			69.6%	23.4%		
Additional needs	Additional needs normalised to 65+ popn	additional need index	weighted population	Older adults weighted population normalised	age and need adjusted populations normalised to total population				Total mental health weighted population
Table 7 Col U * Table 9 Col G	K normalised to Table 7 Col U	L / Table 7 Col U	M * Table 7 Col U * Table 8 Col I	N normalised to Table 7 Col U	G normalised to Table 7 Col R	J normalised to Table 7 Col R	O normalised to Table 7 Col R	P * 7.1% + Q * 69.6% + R * 23.4%	
PCT A	38	34	1.17	34	34	247	250	239	247
PCT B	32	28	1.23	28	28	360	258	196	251
PCT C	31	28	1.15	27	28	237	351	195	306
PCT D	57	51	0.79	52	52	155	142	370	196
Total	158	141	1.00	141	141	1,000	1,000	1,000	1,000

Table 25: Calculate HIV/AIDS treatment and care and HIV prevention weighted populations

	A	B	C	D
	HIV/AIDS Treatment and care		HIV Prevention	
	2008 SOPHID	HIV/AIDS treatment and care weighted population	15-44 year olds	HIV prevention weighted population
	A normalised to Table 1 Col S		Sum Table 1 Cols D to I	B * 0.4 + C normalised to Table 1 Col S * 0.6
PCT A	4	93	90	155
PCT B	5	116	125	210
PCT C	12	279	140	295
PCT D	22	512	104	341
Total	43	1,000	459	1,000

Resource Allocation: Weighted Capitation Formula

Table 26: Calculate DFLE (formerly health inequalities) weighted populations

	A	B	C	D
	Disability free life expectancy (DFLE) 2005	DFLE from 70	DFLE * population	DFLE weighted population
		70-A	B * Table 1 Col S	C normalised to Table 1 Col S
PCT A	55.8	14.2	2,840	302
PCT B	59.9	10.1	2,521	268
PCT C	59.2	10.8	2,703	287
PCT D	65.5	4.5	1,351	144
Total			9,416	1,000

Table 27: Calculate HCHS need index

	A	B	C	D	E	F	G	H
	HCHS need and health inequality weights							
	Acute need	Maternity need	Mental health need	HIV/AIDS treatment and care	HIV prevention	DFLE formula	Need weighted population	HCHS need index
	70.3%	4.2%	14.4%	1.0%	0.2%	9.9%	100.0%	
	Table 4 Col T	Table 5 Col F	Table 10 Col S	Table 11 Col B	Table 11 Col D	Table 12 Col D	70.3% A + 4.2% B + 14.4% C + 1.0% D + 0.2% E + 9.9% F	G / Table 1 Col S
PCT A	226	131	247	93	155	302	231	1.15
PCT B	225	264	251	116	210	268	234	0.94
PCT C	224	357	306	279	295	287	248	0.99
PCT D	325	248	196	512	341	144	287	0.96
Total	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1.00

**Table 28: Calculate PCT MFFs**

	A	B	C	D	E	F	G	H	I	J	K	L
	Host weight 18.9%				Non host weight 81.1%							
	Host MFF indices				Non host Market Forces Factor (MFF) indices from purchaser provider matrix				PCT MFFs			
	Staff MFF	M&D MFF	Land MFF	Building MFF	Staff MFF	M&D MFF	Land MFF	Building MFF	Staff MFF	M&D MFF	Land MFF	Building MFF
									18.9% A + 81.1% E	18.9% B + 81.1% F	18.9% C + 81.1% G	18.9% D + 81.1% H
PCT A	0.95	1.00	0.62	0.92	0.94	1.00	0.77	0.92	0.94	1.00	0.74	0.92
PCT B	0.96	1.00	0.81	0.95	0.95	1.00	0.95	0.95	0.95	1.00	0.93	0.95
PCT C	1.23	1.00	1.58	1.20	1.19	1.02	10.51	1.23	1.20	1.01	8.82	1.22
PCT D	0.91	1.00	1.18	0.96	0.91	1.00	1.02	0.96	0.91	1.00	1.05	0.96

**Table 29: Calculate HCHS MFF index**

	A	B	C	D	E	F	G
	Staff weighted population	M&D weighted population	Land weighted population	Building weighted population	Other weighted population	MFF weighted population	MFF index
	<b>MFF weights</b>						
	54.9%	13.9%	0.4%	2.7%	28.1%	100.0%	
	Table 14 Col I normalised to Table 1 Col S	Table 14 Col J normalised to Table 1 Col S	Table 14 Col K normalised to Table 1 Col S	Table 14 Col L normalised to Table 1 Col S	Table 1 Col S	54.9% A + 13.9% B + 0.4% C + 2.7% D + 28.1% E	F / Table 1 Col S
PCT A	189	199	51	181	200	193	0.96
PCT B	237	249	80	233	250	242	0.97
PCT C	301	253	760	302	250	282	1.13
PCT D	273	299	109	284	300	284	0.95
Total	1,000	1,000	1,000	1,000	1,000	1,000	1.00

Resource Allocation: Weighted Capitation Formula

**Table 30: Calculate the emergency ambulance cost adjustment (EACA)**

	<b>A</b>	<b>B</b>	<b>C</b>
	EACA need factor	EACA weighted population	EACA index
		1.8% * A * Table 1 Col S normalised to Table 1 Col S + 98.2% Table 1 Col S	B / Table 1 Col S
PCT A	0.06	200	1.00
PCT B	0.04	249	1.00
PCT C	0.06	250	1.00
PCT D	0.07	301	1.00
<b>Total</b>		<b>1,000</b>	<b>1.00</b>

**Table 31: Calculate HCHS weighted population**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
	Total population	Need index	MFF index	EACA index	Population * indices	HCHS weighted population
	Table 1 Col S	Table 13 Col H	Table 15 Col G	Table 16 Col C	A * B * C * D	E normalised to A
PCT A	200	1.15	0.96	1.00	222.4	222
PCT B	250	0.94	0.97	1.00	225.0	225
PCT C	250	0.99	1.13	1.00	279.8	280
PCT D	300	0.96	0.95	1.00	272.6	273
<b>Total</b>	<b>1,000</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1,000.0</b>	<b>1,000</b>

PRESCRIBING COMPONENT

Table 32: ASTRO(09)PUs

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Males									Females								
0-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+	0-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+
1.4	1.8	2.9	4.9	9.2	15.9	21.1	0.8	1.0	2.0	2.8	4.0	6.1	9.6	14.5	18.5	1.4	1.8

Table 33: Prescribing crude population

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
	Male population									Female population									Total population
	0-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+	0-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75+	sum A to R
PCT A	6	11	17	15	13	13	10	8	5	6	10	18	14	13	14	11	8	8	200
PCT B	12	19	24	24	18	13	8	6	4	12	18	23	21	15	12	8	7	6	250
PCT C	9	11	14	31	24	14	9	6	5	8	11	16	34	21	14	10	7	6	250
PCT D	8	16	19	16	19	20	21	16	13	7	16	18	12	20	21	22	17	19	300
Total	35	57	74	86	74	60	48	36	27	33	55	75	81	69	61	51	39	39	1,000

Table 34: Calculate prescribing age index

	A	B	C	D
	crude population	Population * ASTRO(09)PUs	Age weighted population	Age index
	Table 19 Col S	sumproduct Table 18 Cols A to R and Table 19 Cols A to R	B normalised to A	D / A
PCT A	200	1,092	205	1.02
PCT B	250	1,034	194	0.78
PCT C	250	1,141	214	0.86
PCT D	300	2,065	387	1.29
Total	1,000	5,331	1,000	1.00

Resource Allocation: Weighted Capitation Formula

Table 35: Calculate prescribing additional need index

A	B	C	D	E	F	G	H	I	J	K	
Prescribing model coefficients								constant			
0.006	0.235	0.855	0.114	0.979	0.157	0.052	0.079	0.333			
LSI (2008)	Prop. >75 years who are >85 years (2008)	Prop. >70 years claiming DLA (2008)	SMR (all ages) (2004-2008)	Generalised fertility rate (2004-2008)	CHD (age standardised QOF prevalence) (2007)	Diabetes (age standardised QOF prevalence) (2007)	Hypertension (age standardised QOF prevalence) (2007)	Population * needs model	Additional need weighted population	Additional need index	
lisi2008	prop85plus	dla_70plus_rate_att2008	smrads	firrate0408	chd_stqof	dm_stqof	bp_stqof	Table 19 Col S * (0.333 + 0.006 lisi2008 + 0.235 prop85plus + 0.855 dla_70plus_rate_att2008 + 0.114 smrads + 0.979 firrate0408 + 0.157 chd_stqof + 0.052 dm_stqof + 0.079 bp_stqof)			
								I normalised to Table 19 Col S	J / Table 19 Col S		
PCT A	21.32	0.23	0.17	1.31	0.05	1.35	1.63	1.19	248	224	1.12
PCT B	24.92	0.21	0.11	0.92	0.09	1.16	3.24	1.48	318	287	1.15
PCT C	18.92	0.25	0.08	1.00	0.05	0.92	1.88	1.19	267	241	0.96
PCT D	8.25	0.30	0.04	0.92	0.05	0.89	1.25	1.00	275	248	0.83
Total									1,109	1,000	1.00

Table 36: Calculate prescribing need weighted population

A	B	C	D	E	F	G	H	I
crude population	Age index	Additional need index	Crude population * age index * need index	DFLE from 70	Population * DFLE	DFLE fomula weighted population 10%	Prescribing need weighted population 90%	Prescribing weighted population
Table 19 Col S	Table 20 Col D	Table21 Col J	A * B * C			F normalised to A	D normalised to A	10% G + 90% H
PCT A	200	1.02	1.12	229	14.2	2,840	302	241
PCT B	250	0.78	1.15	223	10.1	2,521	268	232
PCT C	250	0.86	0.96	206	10.8	2,703	287	219
PCT D	300	1.29	0.83	320	4.5	1,351	144	309
Total	1,000	1.00	1.00	978		9,416	1,000	1,000

## PRIMARY MEDICAL SERVICES COMPONENT

Table 37: Primary medical age-gender weights

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Males							Females						
0-4	5-15	15-44	45-64	65-74	75-84	85+	0-4	5-15	15-44	45-64	65-74	75-84	85+
3.97	1.00	1.02	2.16	4.23	6.01	7.22	3.64	1.04	2.20	3.37	4.95	6.95	8.85

Table 38: Primary medical services crude population

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Male population							Female population							Total population
	0-4	5-15	15-44	45-64	65-74	75-84	85+	0-4	5-15	15-44	45-64	65-74	75-84	85+	
PCT A	6	11	45	23	8	5	1	6	10	45	25	8	5	2	200
PCT B	12	19	66	21	6	4	1	12	18	59	20	7	4	1	250
PCT C	9	11	69	23	6	3	1	8	11	71	24	7	5	2	250
PCT D	8	16	54	41	16	10	3	7	16	50	43	17	12	7	300
Total	35	57	234	108	36	22	6	33	55	225	112	39	26	12	1,000

Resource Allocation: Weighted Capitation Formula

Table 39: Calculate primary medical services age and additional need indices

	A	B	C	D	E	F	G	H	I
					Coefficients		constant		
	Crude population	Population * age/gender weights	Age weighted population	Age Index	0.2612	0.2368	48.1198		
					Standardised limiting long-term illness 2001 Census	Standardised Mortality Ratio, 0-64 ONS 2004 to 2006	Population * need indices	Additional needs weighted population	Additional need Index
	Table 24 Col O	sumproduct Table 23 cols A to N and Table 24 Cols A to N	B normalised to A	C / A	liti	smr64	A * (48.1198 + 0.2612 liti + 0.2368 smr64)	G normalised to A	H / A
PCT A	200	509	202	1.01	144.4	148.3	24,184	220	1.10
PCT B	250	567	224	0.90	133.7	155.9	29,983	273	1.09
PCT C	250	582	230	0.92	121.7	136.9	28,079	256	1.02
PCT D	300	867	343	1.14	89.7	84.6	27,472	250	0.83
Total	1,000	2,526	1,000	1.00			109,718	1,000	1.00

Table 40: Calculate primary medical services DFLE weighted population

	A	B	C	D
	Crude population	DFLE from 70	Population * DFLE	DFLE formula weighted population
	Table 24 Col O	Table 12 Col B	A * B	C normalised to A
PCT A	200	14.2	2,840	302
PCT B	250	10.1	2,521	268
PCT C	250	10.8	2,703	287
PCT D	300	4.5	1,351	144
Total	1,000		9,416	1,000



**Table 41: Calculate primary medical services MFF index**

	A	B	C	D	E	F	G	H	I	J	K	L
						GP pay weighted population	Practice staff weighted population	Land weighted population	Buildings weighted population	Other weighted population	Population weighted for MFF	
						GP MFF weights						
	Crude population	GP pay index	Practice staff index	Land index	Buildings index	42.1%	34.2%	1.3%	6.4%	16.1%	100.0%	MFF index
						A *	A *	A *	A *		42.1% F + 34.2% G + 1.3% H + 6.4% I + 16.1% J	
	Table 24 Col O		Table 15 Col A		Table 15 Col D	B normalised to A	C normalised to A	D normalised to A	E normalised to A	A		G / A
PCT A	200	1.04	0.95	0.51	0.92	204	188	89	182	200	195	0.97
PCT B	250	1.04	0.96	0.57	0.95	255	237	126	235	250	245	0.98
PCT C	250	1.03	1.23	2.81	1.20	251	304	616	299	250	277	1.11
PCT D	300	0.99	0.91	0.64	0.96	290	271	169	285	300	283	0.94
Total	1,000					1,000	1,000	1,000	1,000	1,000	1,000	1.00

**Table 42: Calculate primary medical services weighted population**

	A	B	C	D	E	F	G	H	I	J
	Crude population	Age Index	Additional need Index	MFF index	Population * age * additional need * MFF	Need weighted population	DFLE formula weighted population	Need and DFLE formula weighted population	Need and DFLE formula index	Primary medical services weighted population
						90%	10%			
	Table 24 Col O	Table 25 Col D	Table 25 Col I	Table 27 Col L	A * B * C * D	E normalised to A	Table 26 Col D	90% F + 10% G	H / A	H normalised to A
PCT A	200	1.01	1.10	0.97	216	219	302	227	1.14	227
PCT B	250	0.90	1.09	0.98	241	244	268	246	0.98	246
PCT C	250	0.92	1.02	1.11	261	264	287	266	1.07	266
PCT D	300	1.14	0.83	0.94	271	274	144	261	0.87	261
Total	1,000					1,000	1,000	1,000	1,000	1,000

Resource Allocation: Weighted Capitation Formula

WEIGHTED POPULATIONS, WEIGHTED CAPITATION TARGETS AND DISTANCES FROM TARGET

**Table 43: Calculate unified weighted population, weighted capitation targets and distances from targets (DFTs)**

	A	B	C	D	E	F	G	H
	HCHS weighted population	Prescribing weighted population	Primary medical services weighted population	Unified weighted population	2011-12 opening baseline £	2011-12 opening target £	2011-12 opening DFT £	2011-12 opening DFT %
	78.6%	11.1%	10.3%	100.0%				
	Table 17 Col F	Table 22 Col I	Table 28 Col J	78.6% A + 11.1% B + 10.3% C		D normalised to E	E - F	G / F
PCT A	222	241	227	225	90,000	89,997	3	0.0%
PCT B	225	232	246	228	85,000	91,160	-6,160	-6.8%
PCT C	280	219	266	272	125,000	108,667	16,333	15.0%
PCT D	273	309	261	275	100,000	110,176	-10,176	-9.2%
Total	1,000	1,000	1,000	1,000	400,000	400,000	-0	-0.0%

