Classification: Official

Publication approval reference: PAR1201

Advisory Committee on Resource Allocation (ACRA)

Prescribed specialised services needs-based allocations methodology

24th May 2022

Contents

Summary

This document sets out the proposed methodology for allocating funding to commissioners of specialised services according to need. The Advisory Committee for Resource Allocation (ACRA) seeks feedback on this proposal. The initial focus is on physical health services. Similar work is in progress for mental health services.

The proposed methodology is broadly similar to that used for the allocation of funds for non-specialised secondary care services. ACRA would like to extend this methodology to cover allocations for specialised services. Previously, there has only been a partial model for specialised services. This partial model has not been used for allocations.

The adoption of a needs-based allocation methodology will support the transition to population-based commissioning of specialised services, and the integration of commissioning of specialised and non-specialised services. Needs-based allocation methodology can help not only to achieve equity but also to reveal opportunities for increasing the efficiency of services, including by pre-empting need for specialised services.

The methodology generates a **target relative share of resources** for each integrated care system (ICS). This is based on the needs of the ICS population relative to the population of England.

Actual allocations will take account of other factors, in particular:

- the total to be allocated
- the amount most recently allocated for each population (the baseline)
- convergence policy.

Convergence policy sets out the speed at which allocations can safely move from the baseline towards the modelled distribution, giving local health systems time to adapt services. ACRA is not responsible for these aspects of allocation setting.

The approach to estimating relative need for specialised services is based on individual-level data. The data are pseudonymised and provide a record of service utilisation by each person in England. Econometric modelling is used to uncover how utilisation of specialised resources is associated with characteristics of the individuals

using the services. Utilisation is measured by expenditure on services in the **target-year** and will be zero for most people (as few people use specialised services in any given year). The characteristics used in the model to predict whether a person will incur specialised services expenditure and, if so, how much, are known as **need variables**. The need variables that were expected to predict the need for specialised services include:

- diagnoses taken from the previous two years of individuals' inpatient secondary care[1]
- individuals' age, sex, ethnicity, household structure
- a range of measures of the deprivation and welfare characteristics of the small area where individuals live.

The modelling identifies which of these are associated with spending on specialised services, and to what extent. These need variables are then used to estimate relative need for specialised services across the country.

The model also includes **supply variables**. These are factors that influence utilisation of specialised resources but do not reflect need. These factors might include ease of access to hospital services, if some services are more readily available to providers' local population. Also, some providers may be more costly or charge more for providing the same services. Including these supply factors improves accuracy in estimating the relative importance of the **need** variables. The supply variables themselves are not used in the estimation of relative need.

The need variables are used to estimate what a fair share of funding for each small area would have been in the target year. This is estimated for each GP practice and then combined to create ICS-level estimates of relative need. These are presented in a relative need index. Need-weights are estimated for each age-sex cohort in each GP practice so that they can be applied to practice-level population projections (based on ONS projections of Local Authority populations) for future years. These are then used to create target needs-based ICS allocations for each year for which the allocation is being set.

The variables tested for use in estimating relative need (and the supply variables used to set aside supply effects) are listed and explained in section 2.5.2 of the document

[1] There are groups who used specialised services without needing inpatient care. Whether such need can best be captured using supplementary data, for instance from clinical registries, is noted for exploration in the forward work programme, section 3.1, iii, below.

and in more detail in Annex C. In section 2.6 the process for deriving the final model is described, with a full listing of the model variables and coefficients in Annex E. It turns out that utilisation of specialised services is largely driven by individuals' diagnostic history; and the many diagnostic variables are used in the final model. The impact of deprivation on need is therefore captured via the association between deprivation and morbidity. Age also is largely captured via its impact on morbidity (i.e. the increased richness of diagnostic history of older people, which is directly associated with greater use of specialised services).

Model predictions are not perfectly accurate: there will be random variation in need from year to year, particularly at a GP practice level, which the model will not capture. Aggregated to an ICS footprint, however, the relative allocations produced by the model should be well aligned to true need as far as it has been diagnosed.

The model cannot directly take into account undiagnosed need, as such need will not figure in the morbidity inputs into the model estimation. (It is likely however that undiagnosed need will often be associated with other variables, so that the model will implicitly make some adjustment for this need.) Nor will it fully take into account the need for additional funding to address health inequalities. A separate adjustment is introduced to allow for unmet need and health inequalities.

This document sets out in section 2.7 the relative needs indices by ICS for the model estimated to predict need in 2018/19. The results are also analysed to show how the need for specialised services attributed to a GP practice is associated with the age and deprivation profile of that practice population. This analysis shows that specialised need is strongly related to age. This relationship is, however, less marked than for non-specialised services. Deprivation is also associated with need for specialised services, although not as strongly as age.

For technical reasons, the model of need, and the estimated needs indices presented in section 2.7 exclude HIV and neonatal critical care (NCC)[2] services. (This omission exaggerates the extent to which age is associated with specialised service need.) These services are modelled separately, and the results shown in section 2.8 show their impact on relative need, together with illustrative ICS need indices including these services.

[2] Extracorporeal membrane oxygenation (ECMO) for neonates, infants and children is excluded because it is highly specialised. Post-mortem services are also excluded from the model.

The aggregate model is being re-estimated with 2019/20 as the target year. This will allow the testing of the stability of needs-estimates over time.

The re-estimated needs indices will be used to calculate relative target allocations for future years.

NHS England will determine the pace of convergence. This will be informed by an understanding of the reasons for distance between baseline and target allocations – known as **distance from target**. Pace of convergence should be determined by the feasibility of aligning resource use over time with the needs-based allocations. Distance from target might be explained by variation in:

- ease of access to services (for example, if referral pathways are less well established from communities distant from a provider, this might explain resource use falling short of modelled need)
- the costliness of services at different providers (whether reflecting variations in quality of service or efficiency)
- eligibility thresholds[3]
- the effectiveness of upstream care, for example in primary and community services. Improving these upstream services might be an appropriate strategy to reduce spending on specialised care in some areas. Shining a light on opportunities for such pathway optimisation is a primary purpose of developing needs-based target allocations. There will be flexibility for funding allocated in respect of specialised services for an ICS population to be applied upstream, including for prevention.

The needs-based target allocations will be used to inform allocations from April 2023.

The modelling of relative need is subject to continuous refinement. NHS England proposes to work on a number of areas over the next several years. These are set out in section 3.1.

ACRA seeks feedback on the following questions relating to the methodology for estimating target relative need for specialised services.

[3] There is also known to be variation in the scope of services that are charged to specialised services from place to place. The model allocation makes no allowance for such variation, which will have an equal and opposite impact on distance from target for non-specialised services. Convergence policy will be informed by the overall position of an ICS population with respect to all its allocations.

i. Should the methodology for specialised services allocation follow the established approach for CCG-funded services as far as possible? If not, please explain.

ii. Do you agree that the approach described for modelling specialised need, including adjustments for HIV and NCC services, provides a sound basis for setting target allocations at the current time? Please give reasons.

iii. Do you agree with the proposed forward work programme to refine the model over time set out in section 3.1? Please comment on their relative priority.

iv. Do you agree with the proposed forward work programme to undertake variations analysis to support benchmarking of services set out in section 3.2? Please comment.

v. Are there other issues that you believe should be addressed by the forward work programme?

A set of frequently asked questions and responses is included at Annex F.

A glossary is at Annex G.

1. Overview

1.1 Introduction

The Advisory Committee for Resource Allocation (ACRA) plays a strategic part in the setting of resource allocations to local health systems: currently clinical commissioning groups (CCGs); in the past primary care trusts (PCTs) and, in the future, integrated care systems (ICSs).

ACRA is an independent, expert, technical committee made up of academics, GPs, NHS managers and public health experts. The current membership of ACRA is listed in Annex A. ACRA's role is to develop and to make evidence-based recommendations on the approach taken to estimating the relative need for healthcare resources of different populations, based on the characteristics of those people and the evidence for how their characteristics are associated with future need for healthcare.

These relative need estimates are designed to support the allocation of resources in a way that supports equal opportunity of access for equal need and that contributes to the reduction of health inequalities that are amenable to healthcare. These aims are confirmed when ACRA is commissioned in each allocation round by NHS England. The current commissioning letter for ACRA is provided in Annex B (i), alongside ACRA's most recent letter of recommendations (Annex B (ii)), which includes the recommendation to implement the specialised services needs-based allocation methodology that is the subject of this engagement document.

ACRA makes its recommendations based on the best available evidence. ACRA is supported in this through the work of its Technical Advisory Group (TAG). ACRA and TAG undertake detailed scrutiny of the development work undertaken for allocations and their decisions regarding what formulae constitute the best assessment of relative need are informed by a set of criteria. These are set out in ACRA's terms of reference.[4]

When setting allocations, NHS England will take account of other factors, in particular the total amount to be allocated (the quantum), the amount most recently allocated for the population in question (the baseline), and the speed at which the allocation can safely move from the baseline towards the modelled distribution of resources (the

[4] For ACRA's terms of reference, see: NHS England » Advisory Committee on Resource Allocation (ACRA) terms of reference. The criteria are on page 14.

convergence policy), giving local health systems time to adapt services. ACRA is not responsible for these aspects of allocation setting.

In recent allocations rounds, ACRA has made its recommendations confidentially and feedback has been encouraged only after the allocations have been made. This feedback has been important in steering subsequent development.

As part of ACRA's aim to increase transparency and encourage more feedback, it is trialling a prospective engagement exercise. For the specialised service model, this involves setting out recommendations before they are finalised.

This document sets out and seeks feedback on the specialised services model.

ACRA has recently initiated a review of the health inequalities/unmet need adjustment – this review was commissioned in the NHS Long Term Plan. An adjustment to target allocations, including for specialised services, will be considered following the completion of the review of the adjustment. That adjustment work addresses two related issues:

i. The extent to which allocations should be adjusted to recognise unmet need that is not captured in the utilisation-based modelling of need (particularly need that is undiagnosed, and need that might be more costly to address than allowed for in the utilisation model).
ii. The extent to which allocations should be adjusted to enable commissioning authorities to reduce health inequalities.

Work to assess and to adjust for undiagnosed need, and otherwise to direct funds to reduce health inequalities, is an important complement to the utilisation-based modelling of need here described. Utilisation-based modelling is able to allow for and offset some but not all[5] of the factors responsible for mismatch between service provision and need for healthcare services. Hence, the utilisation modelling discussed here should be understood as only one part of the effort to construct a fair allocation of healthcare resources.

It is ACRA's view that the updated utilisation model for specialised services represents improved estimates of relative need for these services, compared to the current

[5] In particular, where need fails to present at all, often due to deprivation, or where additional costs attend the treatment of socially disadvantaged groups, such need for healthcare resource may escape utilisation models.

(unimplemented) model, and as such will change its assessment of fair shares target allocations.

As well as the specific questions noted at the end of the summary (and repeated below), ACRA would welcome feedback across the full range of these proposals for estimating the relative need for these services. ACRA will not, however, be able to respond to questions relating to the quantum, baselines, or pace of convergence.

1.2 Background to allocations

1.2.1 Legal duties governing allocations

The allocation of funding to local commissioners of services, with which they commission services for their local population is one of NHS England's legal duties.[6] The approach that must be taken in setting allocations is outlined in the mandate from the Department of Health and Social Care[7] which says:

> "The Government expects the principle of ensuring equal access for equal need to be at the heart of NHS England's approach to allocating budgets."

The approach to allocations is also informed by NHS England's duty to have regard to the need to reduce inequalities between patients with respect to their ability to access services and with respect to the outcomes they achieve.[8]

These two aims are reflected in the allocations target formula, which produces a target allocation or 'fair share' for each area, based on a complex assessment of factors such as demography, morbidity, deprivation, and the unavoidable cost of providing services in different areas. They apply equally to the allocation of resources for specialised services required by CCG or ICS populations, notwithstanding that these services are currently commissioned directly by NHS England.

1.2.2 Transition to integrated care systems

The work to strengthen and to implement a needs-based allocation methodology for specialised services has been given additional purpose by the programme to integrate commissioning of services for ICS populations. Constructing needs-based allocations

[6] Section 223G NHS Act 2006, as amended by the Health and Social Care Act 2012.
[7] See https://www.gov.uk/government/publications/nhs-mandate-2018-to-2019 for the 2018/19 mandate.
[8] Section 13G Health and Social Care Act 2012. There is an Equality and Health Inequalities Assessment (EHIA) produced alongside this document that details the expected impact of these proposals on health inequalities and on those with protected characteristics under equalities legislation.

for specialised services at an ICS level will enable commissioners to consider the health needs of their populations in the round, including opportunities to optimise allocation of clinical resource along the typical patient's pathway, considering the best balance between preventative, curative and rehabilitative services.

Existing modelling methodology for estimating need for CCG-populations can readily be adapted to ICS populations, and can therefore be aligned to the modelling of specialised need at that level. ACRA's recommended approach uses a combination of individual-level data and lower-layer super output area (LSOA) population[9] characteristics. Using such granular data means that different geographies can be constructed relatively straightforwardly, and the recommended approach should be suitable for ICSs.

1.3 Target allocations methodology

The formulae for target allocations estimate the relative need and relative unavoidable costs of meeting that need between commissioning areas for healthcare services.

As the need for different types of health services varies across the country in different ways, there are separate formulae for what have been CCGs' core responsibilities (including for general and acute services and for community services), for specialised services (which are currently commissioned directly by NHS England) and for primary medical care. For each of these, relative need is calculated for each GP practice, which is then aggregated to the CCG/ICS level. The methodology does not seek to calculate an absolute level of need for each area, but to assess relative need (and relative unavoidable costs).

The relative need for each practice is estimated on the basis of:

- the diagnostic history, and age, sex and ethnicity, of each member of the population in so far as these are indicative of future healthcare utilisation (all else being equal, areas with older populations typically have a higher need per head largely due to the greater prevalence of health conditions)
- additional need due to factors pertaining to the area in which people live, including deprivation (all else being equal, areas with more deprived populations have a higher need per head)

[9] LSOA populations average around 1,500 people.

- an adjustment to allow for estimated unmet need not captured in the utilisation model, and for funding the reduction of health inequalities (the ‘health inequalities/unmet need adjustment’ discussed in section 1.1)
- the unavoidably higher costs of delivering healthcare due to location alone, known as the Market Forces Factor (MFF) (this reflects that staff, land and building input unit costs are higher in some parts of the country, e.g. London, than in others)
- where relevant, estimates of need have been adjusted to allow for higher costs of providing emergency ambulance services in sparsely populated areas, and the higher costs of unavoidably small hospitals with 24-hour A&E services in remote areas. The forward work programme proposes to explore the relevance of this or similar adjustment to specialised services, particularly to account for any diseconomies of small scale in the provision of specialised services; see section 3.1, iv.

These are all factors describing relative need and properly taken into account when determining a fair allocation of funding.

Each allocation formula is based on statistical modelling that examines the association between the utilisation of health services on the one hand and the characteristics of individual patients and the areas where they live on the other. These models are used to decide which of these need-determining factors to include in the formulae to predict future need per head and what weight to place on each of the factors.

The model also includes **supply variables**. These are factors that influence utilisation of resources but that do not reflect need. These factors might include proximity and ease of access to hospital services, if some services are more readily available to providers’ local populations. Also, some providers may be more costly or charge more in providing the same services. Including these supply factors improves accuracy in estimating the relative importance of the **need** variables.

The supply variables themselves are not used in the estimation of relative need. Technically, this is achieved by setting each of these variables at the national average for every individual, a process known as ‘sterilisation’. This means for example that, in the calculation of relative need, areas are not penalised in the formula for lower utilisation due to relatively lower or less accessible capacity.

The need-variables are used to estimate what a fair share of funding for each small area would have been in the target year. This is estimated for each GP practice and then combined to create ICS-level estimates of relative need. These are presented as a relative need index. The need-weights are estimated for each age-sex cohort in each GP practice so that they can be applied to practice-level population projections for future years. These are then used to create target needs-based ICS allocations for each year for which the allocation is being set.

1.4 Impact of the COVID-19 pandemic

The data used in the development of both the general and acute and specialised services models is from before the COVID-19 pandemic. The assumption is that these models will be representative of underlying relative need for services once the pandemic is over. Separate work is being undertaken in NHS England to look at the scale and relative distribution of the continuing impacts from the pandemic, including long-COVID and elective recovery; if required, off-model adjustments will be made to allocations accordingly. In due course, any enduring impact of the pandemic on relative need will be reflected in future utilisation models.

2. Specialised services needs-based allocation model

2.1 Historical development of the general and acute model

As the general and acute model is well established, and in order to ensure consistency, it is used as the starting point for the development of the specialised services model. The general and acute model covers funding of:

- inpatient spells in hospital and community settings
- outpatient attendances
- A&E attendances
- adult critical care (apart from that funded as specialised services).

ACRA advises that the methodology employed in the general and acute model should also be used in the specialised model unless there is good reason to diverge. This section therefore includes relevant information about the general and acute model as context to the discussion of the specialised model.

Mental health, community (non-inpatient) and maternity services are excluded from the general and acute model as they are covered by separate components in the allocations formulae. Specialised services are excluded as commissioning responsibility for these services is lodged with NHS England and is likely to continue to do so; even if commissioning of many specialised services is delegated to ICSs, as is expected to occur in April 2023, NHS England will retain accountability for them so long as they are designated as specialised. Other services commissioned nationally by NHS England are also excluded from the general and acute model for the same reason.

Since the model for the 2014/15 allocation, ACRA has recommended that relative need per head for general and acute services is estimated using a person-based approach, first developed by the Nuffield Trust.[10] The person-based approach uses anonymised data at the individual level to provide accurate estimates of need, including for small and atypical populations.

In advance of the 2016/17 allocations, NHS England refreshed the Nuffield research using more recent data and re-estimated the models to produce updated weights for different drivers of need.[11] The same approach and methodology as the Nuffield Trust were followed.

A large range of candidate variables are tested for association with subsequent utilisation of healthcare services. The variables that have been found to have a plausible, statistically significant association are those that have been taken forward for the specialised model, and are described in section 2.5.2, below. The exception is that in the general and acute model the supply variables do not include provider-specific variables; the rationale for including these variables in the specialised model is discussed below.

The general and acute model has been part of ACRA's development programme for 2022/23 allocations and a new formula has been developed using updated data and some additions and changes to the model specification. These are described in the

[10] See Bardsley M and Dixon J (2011) Person-based Resource Allocation: New approaches to estimating commissioning budgets for GP practices. Research summary. Nuffield Trust.
[11] https://www.england.nhs.uk/wp-content/uploads/2016/04/3-rep-elland-all-sections.pdf

relevant documents within the Allocations website: https://www.england.nhs.uk/allocations/.

2.2 Historical development of the specialised model

Target allocations for specialised services were developed for the first time for CCG areas for the 2016/17 allocations round, and again to inform 2019/20 allocations. These target allocations for specialised services were indicative only and were not used to distribute specialised service resource, although they did support a better understanding of total expenditure for a CCG's population.

The formula used to create the specialised services indicative allocation followed the same approach and used the same dataset as the formula informing the 2016/17 allocation for general and acute services. The model was developed to explain variation in costed activity data in the 2013/14 target year. The SUS+[12] dataset used for the modelling had poor coverage of some specialised services and it was not possible to model all specialised services. The dataset coverage allowed the formula to be used for 46% of specialised services funding. The other 54% of specialised services, where coverage in the dataset was poor, were distributed in the indicative allocation in line with the historical pattern of spending as the best estimate of need for these services. The scope of the formula component changed from 46% to 49% for the indicative specialised model prepared ahead of 2019/20 allocations.

2.3 Context

Prior to the consideration of delegating some specialised services to ICSs, ACRA had already been commissioned to look again at the approach to estimating needs for specialised services, in particular to look at reducing the proportion of need that was estimated using historical provision.

As mentioned, the proposals for integrating commissioning of specialised services with that of other services for ICS populations make this more important. ICSs require appropriate financial information for specialised services to inform meaningful commissioning decisions for all patients in their population. Currently, with resource mapped on a provider (rather than population) basis, and contracted at regional level, opportunities for better patient care and increased efficiency may be missed in services where early intervention and more joined up pathways of care would improve services

[12] SUS+ is the Secondary Uses Service dataset that contains patient-level data for hospital activity.

at a reduced cost. A needs-based target allocation on a population basis will highlight where existing service utilisation is higher or lower than modelled need, suggesting scope for optimisation, as well as to bring about fairer distribution of resources.

As the next stage in the development of a specialised services formula, we have focused on physical health. In due course, we intend to develop mental health service models also.

The recommended model also excludes:

- highly specialised services (HSS) and the Cancer Drugs Fund (CDF) and the new Innovative Medicines Fund, as these are assumed to be commissioned nationally.

Both the data and the model parameters used in modelling physical health services have been validated through discussion with clinicians from the clinical reference groups expert in the various specialist programmes of care. Engagement with clinical leadership is continuing and is supported by the creation of sub-models for four major services: cancer, renal, cardiac and neuroscience services. The sub-models will be used to gain a better understanding of both the variation in need and the service-specific variation in the meeting of that need; they will not be used for allocating funds.

2.4 The specialised services model

ACRA agreed early in the process of developing the specialised services model that, where possible and where it made sense to do so, the specifications of the general and acute and of the specialised services models should be aligned; the models are very similar and the majority of the datasets and variables are the same.

An important difference is that the new specialised services model uses an alternative dataset to represent the utilisation of services (the dependent variable). The general and acute model (like the previous version of the specialised model) uses cost-weighted activity to represent utilisation, with cost-weights given by published tariffs and other sources for services reported in SUS+. As far fewer specialised services are covered by cost-reflective prices, this approach greatly restricted the number of services that could be covered. The current specialised model instead represents utilisation of in-scope specialised services by unweighted commissioner expenditure: using the unweighted patient-level charges sent by providers to commissioners in the patient-level contract monitoring (PLCM) datasets. This has significantly improved the proportion of specialised services that are covered by the model.

One drawback of using the PLCM datasets rather than cost-weighted activity is that the price of a service varies from provider to provider, even after adjusting for unavoidable cost differences using the MFF. The introduction of provider specific supply variables allows the effects of variance due to differences in provider prices to be removed from the modelling. In estimating relative need, the impact of these supply variables is neutralised by setting them at average values for all individuals, effectively estimating the relative utilisation of specialised resources of different individuals as if all individuals were served by the same typical provider of specialised services, at average prices.

In general, there is thought to be no link between differences in provider prices for specialised services and population need, so that it is appropriate to set such differences aside (in the way described) when estimating relative need. Rather, decisions will have been made over time as to the level of investment in individual services (e.g. number of medical staff and the creation of multi-disciplinary teams staffed with specialist nurses and psychologists etc.) which will contribute to different cost bases for the same service in different providers. To an extent these are reflected in local prices and may determine quality of service but are appropriately set aside in estimating relative need. Variation in local prices may also reflect geographical variation in provider efficiency or in negotiating power between providers and commissioners, and thus not reflect differences in efficient-costs at all; here too such variation is correctly set aside so as not to influence estimates of relative need.

There is nonetheless a risk that some of these provider-specific variables, which are designed to be suppressed when estimating relative need, to some extent capture genuine need. Higher costs specific to a provider may reflect a higher level of need associated with their patients.

A related concern is that patients with persistent need for specialised services may move to be close to specialised providers. The provider specific variables may in that case be capturing the needs of those additional patients for specialised services.

In both cases the concern only arises if the diagnostic information about the patients needing specialised services does not sufficiently distinguish them from other patients; otherwise their additional costs and additional need would be fully represented through the diagnosis variables. In the forward work programme, we intend to explore use of finer diagnostic groupings, particularly for long term conditions, which would mitigate any problem; see section 3.1, iii.

Regarding patients moving near to care providers, at least for some services it may in any case be more appropriate for funds to be allocated to places where need arises originally. Nevertheless, if respondents (including respondents to this engagement) suggest that that this is a significant issue (and can suggest particular services where it arises), evidence could be sought regarding patients' tendency to relocate subsequent to diagnosis of persistent need for specialised services. (See also FAQ 24 in Annex F.)

There are other drawbacks to the use of the PLCM datasets: there is likely to be considerable variation in the practice of counting and coding activity and recording it in the PLCM datasets (although this is also an issue with SUS+). Some activity that is paid for in a block will not make it into the PLCM at all – or may be recorded at zero cost.

However, so long as a good proportion of service usage for each service line is covered (see next section), the estimation of the needs-drivers should be sound. Note that the PLCM is being used to create the set of patient-level specialised resource costs; the modelling then assesses what it is in the personal history of all those patients who have incurred those costs that is suggestive of future recourse to specialised services, drawing on the joined pseudonymised full inpatient medical history of just those patients. Absence of other patients whose costs are not known to the model will not vitiate the modelling so long as the patients caught by the PLCM are an unbiassed sample of all patients. (One additional concern is that the variation in PLCM coverage of different services might introduce a bias in the estimation of need if those services vary in the pattern of their need. This issue is discussed further in the forward work programme, section 3.1, ii.)

Biases relating to different coding and counting practices in different providers should be captured by the provider-specific variables, which are modelled but not used in estimating relative need.

2.5 Data to be modelled

2.5.1 The dependent variable

As described above, the previous specialised services model used data from the SUS+ dataset, which was insufficiently comprehensive and only around half of specialised services spend could be modelled. For the current model, the PLCM datasets have been used to create the dependent variable for the model – the specialised services expenditure on each person during 2018/19. The modelling of need shown here is being repeated using the same 2019/20 dependent variable. It is intended that relative

need from that year will be that used to inform target allocations. Stability of relative need between the two years gives assurance of modelling robustness.

Three patient-level datasets are collected by specialised commissioning for the purposes of monitoring contracts:

- the Patient Level Contract Monitoring (PLCM) dataset, which covers all NHS funded acute clinical care
- the Drugs Patient Level Contract Monitoring (DrPLCM)
- the Devices PLCM (DePLCM).

Taken together these datasets should cover all the specialised services funded by NHS England.

The use of the PLCM dataset has led to a significant increase in the coverage of the model; it covers 94 of 118 (80%) specialised service lines at a threshold that enables services to be modelled. The agreed threshold was that 40% or more of the estimated full expenditure on the services (as estimated from analysis of Final Outturn Expenditure by NHS England on specialised services) is accounted for in the PLCM. These service lines account for 84% of in-scope specialised services spend (excluding highly specialised services and specialised mental health services).

Specialised services have a higher average cost and wider variation in costs than general and acute services, therefore outliers for specialised services have been considered separately to those for the general and acute model. Analysis showed that alternative treatments of outliers in the specialised services model had little impact on goodness of fit in the model. Further analysis of outliers in the PLCM in 2019/20 has shown that the outliers are consistent across years. Following this analysis and clinical feedback, outlying costs have not been removed or capped in the specialised services model.

Services for which the 40% threshold was not achieved are dealt with in two different ways.

For the smaller services (specialised cancer diagnostics, £112 million in 2018/19; cancer ‘to be decided’, £1 million; hyperbaric oxygen therapy, £8 million; specialised maternity services, £1 million; infectious diseases £168 million) it is proposed that the funding be distributed in line with the model, as the ICS variation in need for these

services is unlikely to diverge materially from that for modelled specialised services. Therefore, spend for these services can be distributed using the needs-based model.

There are two areas of significant spend that are notable exceptions – HIV and neonatal critical care (NCC). Data for HIV is anonymised and therefore cannot be joined to the person-level dataset for modelling. The cohort nature of the model, taking a registered population at the start of April 2018 to whom to attribute specialised services utilisation, means that NCC expenditure is not captured for children born during the year. These children in any case have no existence in the base years used for predicting relative need.

The modelling of allocations for these services, discussed in section 2.8 below, is added to the main allocation to create an inclusive target allocation. To aid transparency, however, the needs indices presented below in section 2.7 are **exclusive** of these two services.

The scope of specialised services can change over time with the introduction of new services. Generally, on introduction, these services will not materially affect the appropriate allocation to ICS populations, given the small scale of new innovations relative to the overall budget, that common factors (age-related morbidity adjusted for deprivation) that drives the need for most specialised services, and the limited pace of convergence in allocations towards target allocations. However, over time, innovations cumulate. This, together will demographic change, necessitates periodic remodelling of need.

2.5.2 Explanatory variables

An extensive set of explanatory variables were gathered for testing in the model. The starting point for this list were the variables tested in previous iterations of the general and acute model. The need and supply variables tested in the model are summarised in Tables 1 and 2, below, respectively. A full list is in Annex C, which also describes the process by which variables were selected for inclusion in the econometric estimation using Principal Component Analysis. The final list of variables included in the 2018/19 recommended model is shown in Annex E.

Table 1: Need variables

Explanatory variable	Description	Rationale
Morbidity flags, co-morbidity flags, number of diagnoses	Historical diagnosis data, including up to a dozen diagnoses, collated for all inpatient episodes and spells in 2016/17 and 2017/18 from the SUS+ dataset for the April 2018 cohort of GP registered patients. These diagnoses data are used to create morbidity flags, indicating a past diagnosis of a condition in one of the World Health Organisation defined sub-chapters of the International Classification of Diseases (ICD). (The classification of diagnoses for this purpose is subject to further analysis; see section 3.1, forward work programme, iii.)	Historical diagnoses are likely to be associated with enduring morbidity, that is in turn predictive of future need for healthcare. Diagnoses will vary in their predictive power, so are modelled individually. The use of two years of historical diagnosis data is consistent with both the Nuffield PBRA 2011 model and the 2016/17 update. This reflects the diminishing explanatory power of historical data on future hospital costs with time. Additional co-morbidity flags are also included that take account of how having many different diagnoses can increase or decrease the relative need compared to the sum of having each diagnosis alone. These are based on the higher-level ICD chapters.
Morbidity counts	A morbidity count variable constructed to indicate where an individual has had a particular diagnosis recorded three of more times during 2016/17 and 2017/18.	This was based on the hypothesis that having a diagnosis recorded more frequently indicates a higher level of need. The count of diagnoses recording was capped at three or more to avoid including supply effects in the model.
Age, sex and area of residence	Age, sex and LSOA of residence taken from the GP registrations data Master Patient Index (MPI). Data based on April 2018.	Age-sex cohorts may have different propensity to need healthcare resource independently of the set of diagnoses that have been collected for those individuals. Area of residence is used to attribute characteristics to individuals, listed below, that are unavailable at an individual level (notably deprivation).

Explanatory variable	Description	Rationale
Ethnicity	Each individual's ethnic group assigned using a range of patient-level health datasets. This assignment identified the ethnic group for 61% of individuals. For the remaining population an area-based proportion is used (an attributed area-based variable from the Census). Ethnicity is included by ethnic group (16 groups).	Ethnicity may drive need either due to differences in biology or culture that drive variation in health need, or to variation in access to upstream services. It can also sometimes be associated with failure to present need – see discussion in section 2.7.2 below.
Privately funded care flag	A flag created for anyone with any privately funded care episodes recorded in SUS+ in 2016/17 or 2017/18.	Use of privately funded care is predictive of future such use, which in general will reduce likely recourse to NHS funded services.
New registrations	A flag for whether someone was newly registered with their current GP, based on the previous 12 months. Based on registration in 2017/18.	Modelling has consistently found that being newly registered with a GP was associated with higher cost.
Household composition	Linking the MPI to the anonymised Unique Property Reference Number (UPRN) allows identification of all individuals resident in a property and derivation of a household type variable that indicates the composition of the household as: care home; other communal establishment; two adults and one or more children; multi-adult and one or more children; two adults of the same gender; two adults of different gender; one adult and one or more children; or single person.	Household status may prove predictive of need for specialised services.
The following need variables are only available for small geographical areas (LSOAs) rather than for individuals, so individuals are attributed with the value for the LSOA in which they reside.		
Variables from the ONS Census of Population	A range of variables relating to population characteristics from the 2011 census: proportion of single	Any of these may prove predictive of vulnerability to conditions requiring specialised resource.

Explanatory variable	Description	Rationale
	pensioner households, proportion aged 16-74 who have never worked, proportion who are single, proportion divorced, proportion renting, proportion reporting 'not good health.'	
Index of Multiple deprivation	The underlying indicators from the Index of Multiple Deprivation. Updated for IMD2019, using underlying indicators rather than composite scores.	Deprivation may be predictive of healthcare need in addition to the effect captured through the association of deprivation with morbidity – which is flagged at an individual level.
Log population variance	Log of the variance between registered and resident populations for each LSOA. Updated to 2018 populations.	To allow modelled need to be driven by the actual resident population irrespective of how many individuals are registered or of any list inflation.
Variables from the Department of Work and Pensions	Eligibility for Disability Living Allowance (DLA) or Personal Independence Payment (PIP)	Disability may be predictive of healthcare need over and above its association with morbidity.
Quality outcomes framework data	QOF indicators including kidney disease total exceptions, epilepsy prevalence, mental health prevalence. Updated to 2018/19.	May pick up morbidity that has not been diagnosed in the secondary care data used to provide individual-level morbidity.
GP survey	A range of indicators from the GP survey (including average number of medical conditions for those with at least one, listed in Annex C). Updated to 2018.	To capture the burden of need prevalent at different practices.

Supply variables

As explained above, the utilisation of healthcare may also be affected by the relative availability of healthcare services. Variables were tested in the modelling to adjust for this, known as supply variables. These variables included for example waiting times and distances to hospitals. While these variables were included in the models as they affect utilisation, they are not included in the formula to calculate relative need; instead their value for each area was set to the national average (sterilised).

Table 2: Supply variables

Explanatory variable	Description	Rationale
Travel duration to hospital sites	Gravity[13] weighted travel duration from an LSOA to all hospital sites. We have tried various specification of the distance variable, to take account of the distance to relevant specialist hospitals, including in the sub-models. We have also explored whether distance might particularly be a problem for the elderly or the deprived.	Access to care may be deterred by travel distance, either because patients are unable or unwilling to travel, or due to attenuation of referral networks (primary and secondary care doctors are more likely to refer to tertiary centres with whom they have established connexions).
Hospital supply variables	A range of gravity weighted variables for each LSOA, including median waiting times, diagnostics, and numbers of beds/operating theatres. Updated to 2018/19.	Supply constraints may lead to prioritisation of local patients in accessing each of these types of services; if so, estimation of need must make allowance for the fact that local patients will use disproportionately more services.
Provider-specific variables	The share of the patients at a GP practice that have received specialised care at each provider during 2016/17 and 2017/18.	As highlighted above, the dependent variable for the specialised services model includes the actual cost to commissioners of activity. Provider variables in the specialised model account for provider variation in the pricing, efficiency or quality of services, and for provider-specific access issues.
GP workforce survey	A range of variables relating to GP workforce. Updated to 2018	Constrained supply of GP services may suppress or delay referral for specialised need, and this should be taken into account when estimated underlying need.
Quality outcomes framework scores and exception rates	Weighted scores and exception rates from the quality outcomes framework (QOF) were also tested as supply variables. Updated to 2018/19.	Quality of primary care may determine likelihood of referral for specialised services.

[13] 'Gravity weighting' involves giving weight according to the inverse of the square of the distance: in the same way that gravity is inversely proportional to the square of the distance between two bodies, so the likely impact of proximity to a healthcare facility on utilisation diminishes with the square of the distance.

Explanatory variable	Description	Rationale
CCG quality of care	Age/sex standardised avoidable admissions defined as per NHS Oversight Framework indicator 106a.[14] The residuals of a regression of this indicator at LSOA against the Index of Multiple Deprivation was taken as an inverse indicator of quality of CCG-commissioned care, as it should be sensitive both to access and to quality of primary and secondary care.	Poor quality of CCG care might be expected either to increase the recourse to specialised care (as exacerbations are not avoided), or to depress it (as severe conditions are left untreated with appropriate specialised care).
CCG-specific variables	A flag for each individual indicating which CCG is responsible for commissioning their healthcare – based on the GP practice at which they are registered. Configuration of CCGs as of 2018/19.	CCGs may vary in the scope and quality of primary and secondary care services, which may affect demand for specialised services; they may also vary in negotiating power which may affect expenditure.

It is worth noting that the model implicitly disentangles age from the morbidity with which it is associated, and most of the work is indeed likely to be done by morbidity – but the result is to allocate more funding to older populations, on account of their greater morbidity.

More generally, the model will use the detailed diagnostic histories of individuals to forecast need in different ways for different conditions:

- for persistent conditions, including genetic conditions, where these are captured in the dataset, the model will forecast resource use directly for those patients who are currently receiving services
- for acute conditions for which treatment is curative, the model will predict resource use on the basis of personal attributes including age and other morbidities that it discovers to be predictive of such need
- some funding will be attributed even to young and healthy individuals given the small risk we each run of needing specialised resources in a year or two.

[14] CG IAF https://www.england.nhs.uk/publication/ccg-iaf-data-extract/ Guidance: https://www.england.nhs.uk/wp-content/uploads/2018/11/technical-annex-1819-v1.3.pdf

2.6 Model specification

2.6.1 Age functional form

In the previous model iteration, age was introduced as a series of 18 variables each representing an age group in 5-year intervals up to 85 plus. Such age variables were interacted with sex for sex-specific age costs. During the model development an alternative method of accounting for age and sex was tested through using linear or cubic splines with a number of different knots (5 to 18 knots).

The use of splines allows the impact of age on predicted costs to vary within age groups. Rather than fitting a single coefficient for each age group, the splines allow the coefficients to vary within the age group.

The use of splines improved the performance of the model. The optimal number of knots proved to be 17 or 18. To allow for more flexibility in the older groups, the decision was to implement linear splines with 18 knots.

2.6.2 Number of diagnostic positions

In the updated dataset the number of secondary diagnostic positions that can be recorded has increased to 23 (compared to 13 diagnostic positions in the dataset for the 2016/17-allocations model update). The optimal number of positions used to create the morbidity binary flags was therefore examined. Changes in model fit were minimal after the use of 13 secondary positions, although 23 diagnostic positions performed best.

Significant variation in the depth of coding between providers was observed which could introduce bias into the model as patients attending providers with greater depth of coding could have more morbidities and co-morbidities identified. About 95% of individuals had 14 diagnoses or less recorded per provider. Consideration of the 95th percentile of diagnoses recording suggested that the vast majority of providers coded to around 10 to 12 positions with all providers having a maximum number of diagnoses of at least 12.

Other tests included looking at the same individual being treated at different providers and the way that other model variables change as the number of secondary diagnoses included in the model change.

Considering depth of coding, goodness of fit statistics and provider coding distributions and the diagnostics testing, 12 secondary diagnostic positions were chosen as this

struck the best balance between making the best use of the data that is available without introducing bias into the model due to differences in depth of coding by providers.

2.6.3 Model variable selection

Given the large number of candidate variables in the model and the associated risk of overfitting the model, a variable selection process was conducted to obtain a list of attributed variables that are associated with utilisation of specialised services. This is described in Annex C. A stepwise approach as described below was then used to select variables for the final model.

Variable selection was undertaken on an individual-level estimation sample (S1). This was a 15% randomly selected sample of 8,870,118 individuals from 7,218 GP practices. The final coefficients for the selected variables are then calculated using the whole dataset.

Stepwise T-statistic selection method:

a. The first step selects the relevant co-morbidity flags and morbidity intensity counts. A baseline model containing age splines, sex, their interaction, morbidity flags and co-morbidity flags is created. Co-morbidities and morbidity intensity with t-statistic >3.27 are retained as highly significant and relevant. All other co-morbidity and morbidity intensity variables are dropped.

b. In the second step, a ‘full model’ containing all of the candidate variables is estimated using S1.

c. All attributed variables with t-statistic <0.2 are then removed from the model.

d. After step c, we re-run the model but without variables omitted in stage c. We then remove all attributed variables with t-statistics lower than 0.4.

e. We repeat the process described in step d, increasing the t-statistic by 0.2 for each iteration, until we have removed all attributed variables with a t-statistic of under 2.58.

In line with ACRA’s previous recommendations, some collections of variables are considered together as a group. If any are significant, the whole group is retained in the model. For the specialised services model this is true for age, sex, ethnicity, household type, historical diagnoses, provider-specific variables, and CCG-specific variables.

2.7 Final recommended models for specialised services physical health service excluding HIV and NCC

2.7.1 Aggregate physical health services model (excluding HIV and NCC)

Statistical modelling was used to select the 'best fit' drivers of relative costs from the set of explanatory variables at the person level and the relative weights for each driver, as well as to exclude groups of variables that included no statistically significant impact. The quantified relationships found were taken to be predictors of relative future, cost-weighted need for healthcare services, subject to supply variables being set to the national average values (sterilised).

Consistent with previous person-based resource allocation modelling approaches, three random samples were used to estimate and validate the models:

- Sample S1 – the individual-level estimation sample. This was a 15% randomly selected sample of 8,870,118 individuals from 7,218 GP practices.
- Sample S2 – the individual-level validation sample. This was a random sample of 15% of 8,861,680 individuals from 7,220 GP practices. Samples S1 and S2 were mutually exclusive, so no individual was in both samples S1 and S2.
- Sample S3 – GP practice-level validation sample (containing all registered patients from a sample of GP practices). This was all those registered with a randomly selected sample of 15% of GP practices with 1,000 or more patients. This sample had 8,432,418 individuals from 1,044 GP practices.

The variables tested for use in estimating relative need (and the supply variables used to set aside supply effects) were summarised and explained in section 2.5.2 above, and are listed in Annex C. The result of the variable selection process was to reduce the model to that set out in Annex E.

It turns out that utilisation of specialised services is largely driven by individuals' morbidity, represented in the model by their diagnostic history; and these factors are used in the final model. The impact of deprivation on need is therefore captured only indirectly – via the association between deprivation and morbidity. Age also is largely captured via its impact on morbidity (i.e. the increased richness of diagnostic history of older people, which is directly associated with greater use of specialised services).

Residence in a care home is associated with reduced recourse to specialised services (perhaps due to frailty). The African, Caribbean, and Other Black ethnicity flags are associated with additional need for specialised services.

The flag for whether someone was newly registered with their current GP was not found to be significant for specialised services.

Of the attributed variables, the proportion of people in an area that are eligible for Disability Living Allowance (DLA) or Personal Independence Payment (PIP) proved significantly predictive of specialised healthcare need over and above its association with morbidity.

Among the supply variables, neither the measure of CCG quality of care nor the measures of travel time proved significant. However, effects of these factors may have been captured in the individual CCG-specific and provider-specific variables.

The full set of coefficients for the specialised services model is in Annex E.

The final model explains 50% of the variation in specialised services costs at the GP practice level. This is to be compared to the 85% of the variation in cost-weighted general and acute activity that is explained by the model for those services. It is to be expected that the model for specialised services explains less variation than the general and acute model. There is a much smaller proportion of the patient cohort with costs for specialised services, and – to the extent that this incidence is unpredictable – there is therefore greater scope for random variation in the incidence of specialised conditions at a practice level. ACRA judges this level of explanatory power adequate for the purpose of estimating relative need at higher levels of aggregation (and specifically at the level of ICSs).

2.7.2 Calculation of need indices for aggregate physical health model

Once the variables and their weight in driving need have been determined by the model, weighted populations are produced for each GP practice, which can then be summed to ICSs to reflect relative need for healthcare in each area. This is done by first calculating average cost weights for each age-sex cohort in each GP practice. These cost weights are then applied to current GP populations to calculate the weighted population for each GP practice. Using age-sex cohorts (rather than individuals) as the bearer of the population weights enables resource-need to be projected forward for a practice with sensitivity to demographic change using ONS population projections.

At this stage the supply variables have been set to national averages, so that they do not affect the estimation of relative need. As mentioned, this is so that estimates of need are not influenced by variation in the extent to which patients have access to services (captured in both the CCG- and provider-specific variables), or by variation in the efficiency with which services are provided (captured by the provider-specific variables).

In addition, ACRA is recommending that where ethnic groups had negative coefficients in the model (indicating lower use of health services) these should be set to zero (i.e. matching the White-British group), as negative coefficients are likely to reflect unpresented need rather than lower levels of need for these groups.

The GP practice-level weighted populations are summed to ICSs and reflect relative need for healthcare in each area. Weighted populations have been produced for ICSs as opposed to CCGs as the needs-based model will not start to drive allocation of resources to local areas until ICSs are in place.

Weighted populations are used to calculate a need index for each ICS by dividing the weighted population by the total registered population. **A value above 1 indicates higher than average need and a value below one indicates lower than average need.**

2.7.3 ICS need indices for aggregate physical health services excluding HIV and NCC

The need indices for the specialised model for each ICS/STP are in Table 3, below. The first column shows the estimated relative need for each area. Target allocations are calculated based on the share of the needs-weighted population in each ICS.

The second column shows relative need for **age and gender standardised populations**: this shows for each area what their relative need estimate would have been if they had the age-gender profile of England; the purpose of this column is to display the impact on estimated need of all the **other** factors driving need apart from the age and gender profile (and its associated morbidity profile).

The third column – showing the difference between the two – displays the impact of age and gender on estimated need.

The top row, for East London, for example, shows that other factors – including relative morbidity and deprivation – indicate a heavy burden of need, 12.7% above the norm in the age-gender-standardised column. But this is more than offset by the fact that the

population in this ICS is relatively young, so that overall modelled need for specialised services, at 0.89, is 11% below the national average.

The cartograms immediately below show the same information. Overall, the impact of age and gender on estimated need outweighs the impact of other factors (the average absolute difference from mean age-gender-standardised need is 4.7%, while the average impact of age and gender is 7.4%).

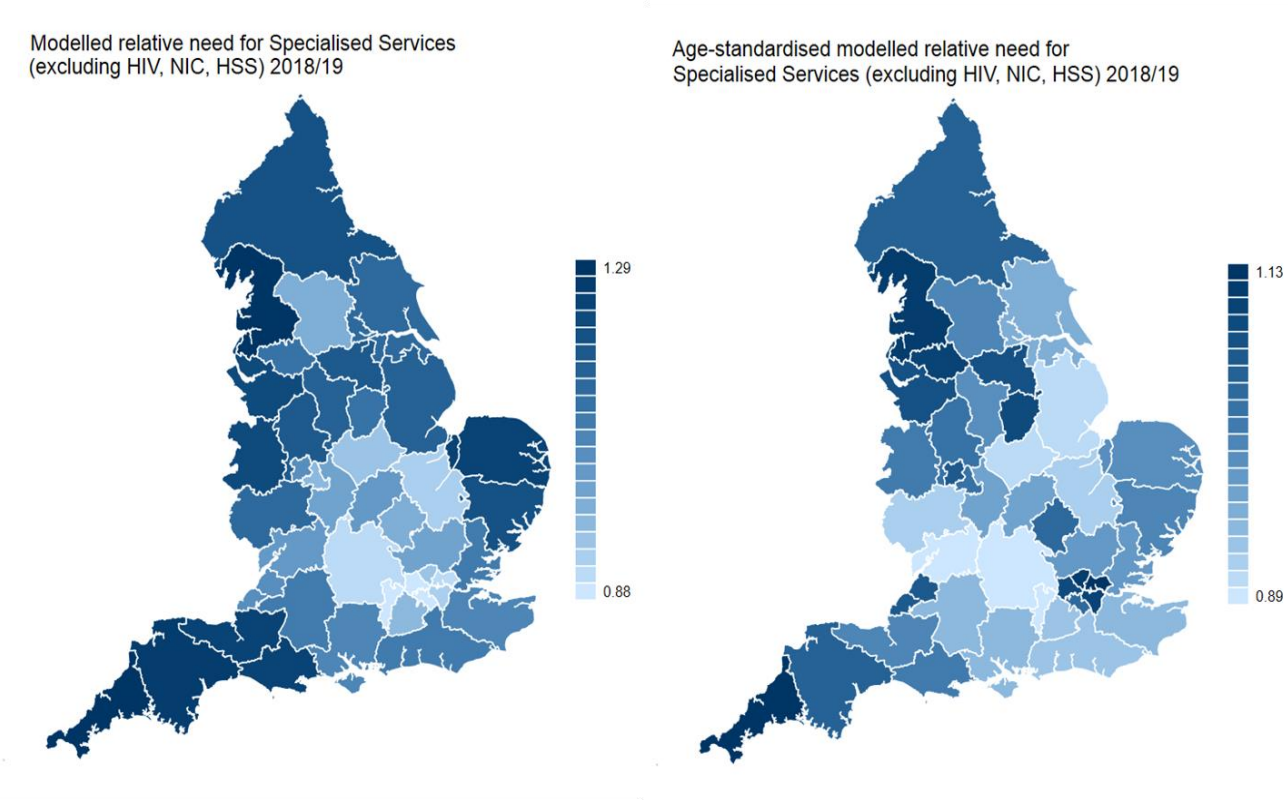


Table 3: Needs indices by ICS, age-gender standardised

Modelled Relative Need for Specialised Physical Health Services Excluding HIV, NIC, HSS, CDF by STP in 2018/19					
STP19 (42) Sustainability and Transformation Partnerships	**Region19 (7)**	**STP**	**Modelled Relative Need**	**Age/gender Standardised Relative Need**	**Age/gender Impact on Relative Need**
East London Health & Care Partnership (STP)	London	QMF	0.890	1.127	-21%
North London Partners in Health & Care (STP)	London	QMJ	0.917	1.102	-17%
North West London Health & Care Partnership (STP)	London	QRV	0.881	1.044	-16%
Our Healthier South East London STP	London	QKK	0.899	1.059	-15%
South West London Health & Care Partnership (STP)	London	QWE	0.877	1.003	-13%
Bath and North East Somerset, Swindon and Wiltshire STP	South West	QOX	1.003	0.943	6%
Bristol, North Somerset and South Gloucestershire STP	South West	QUY	0.989	1.019	-3%
Cornwall & Isles of Scilly H&SC Partnership (STP)	South West	QT6	1.291	1.118	15%
Devon STP	South West	QJK	1.134	1.004	13%
Dorset STP	South West	QVV	1.125	0.984	14%
Gloucestershire STP	South West	QR1	0.987	0.904	9%
Somerset STP	South West	QSL	1.125	0.982	15%
Buckinghamshire, Oxfordshire and Berkshire West STP	South East	QU9	0.889	0.893	0%
Frimley Health & Care ICS (STP)	South East	QNQ	0.879	0.905	-3%
Hampshire and the Isle of Wight STP	South East	QRL	0.990	0.944	5%
Kent and Medway STP	South East	QKS	0.990	0.944	5%
Surrey Heartlands Health & Care Partnership (STP)	South East	QXU	0.960	0.929	3%
Sussex and East Surrey STP	South East	QNX	1.005	0.937	7%
Birmingham and Solihull STP	Midlands	QHL	0.940	0.994	-5%
Coventry and Warwickshire STP	Midlands	QWU	0.965	0.967	0%
Herefordshire and Worcestershire STP	Midlands	QGH	1.039	0.925	12%
Joined Up Care Derbyshire STP	Midlands	QJ2	1.050	0.980	7%
Leicester, Leicestershire and Rutland STP	Midlands	QK1	0.915	0.918	0%
Lincolnshire STP	Midlands	QJM	1.040	0.915	14%
Northamptonshire STP	Midlands	QPM	0.973	0.968	1%
Nottingham and Nottinghamshire Health and Care STP	Midlands	QT1	1.025	1.044	-2%
Shropshire and Telford and Wrekin STP	Midlands	QOC	1.094	0.986	11%
Staffordshire and Stoke on Trent STP	Midlands	QNC	1.072	0.999	7%
The Black Country and West Birmingham STP	Midlands	QUA	0.989	1.018	-3%
Bedfordshire, Luton and Milton Keynes STP	East of England	QHG	0.962	1.003	-4%
Cambridgeshire and Peterborough STP	East of England	QUE	0.899	0.924	-3%
Hertfordshire and West Essex STP	East of England	QM7	0.971	0.971	0%
Mid and South Essex STP	East of England	QH8	1.022	0.979	4%
Norfolk and Waveney Health & Care Partnership (STP)	East of England	QMM	1.115	0.981	14%
Suffolk and North East Essex STP	East of England	QJG	1.086	0.982	11%
Cheshire and Merseyside STP	North West	QYG	1.091	1.043	5%
Greater Manchester H&SC Partnership (STP)	North West	QOP	1.025	1.069	-4%
Healthier Lancashire and South Cumbria STP	North West	QE1	1.160	1.089	7%
Cumbria and North East STP	N E and Yorkshire	QHM	1.074	1.011	6%
Humber, Coast and Vale STP	N E and Yorkshire	QOQ	1.038	0.957	8%
South Yorkshire and Bassetlaw STP	N E and Yorkshire	QF7	1.051	1.034	2%
West Yorkshire and Harrogate (H&C Partnership) STP	N E and Yorkshire	QWO	0.962	0.982	-2%

2.7.4 Impact by age and deprivation

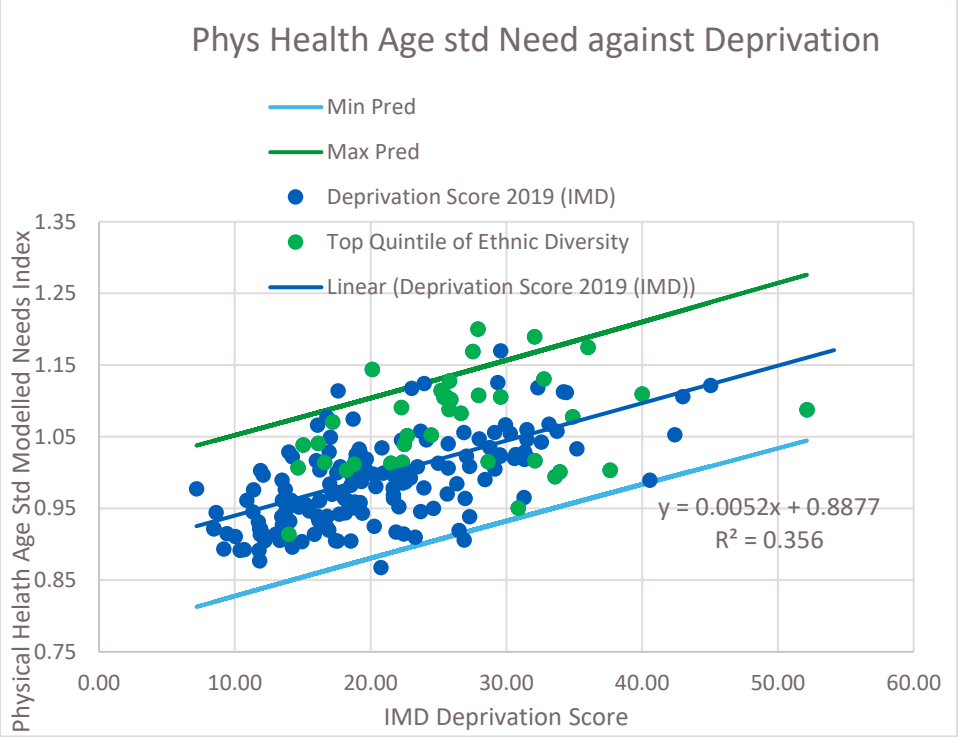
The need indices for age and IMD quintiles are shown in Table 4 below. These quintiles are derived by assigning each GP practice to an age and deprivation quintile based on the characteristics of their registered population. In this way it is possible to examine how needs indices vary by age and deprivation for different models. As with the model for general and acute services, so also for the model of specialised service need there is a pattern of higher need for areas with older more deprived populations and a lower level of need in areas with younger less deprived populations. There is, however, somewhat less variation across the age and deprivation matrix for specialised services than is seen for general and acute services: the need indices for areas with young and less deprived populations for specialised services are less than one but higher than for general and acute services; and areas with older more deprived populations have needs indices that are above one but lower than for general and acute services.

Table 4: Need indices for the specialised services model by age/deprivation quintile (excluding HIV and NCC)

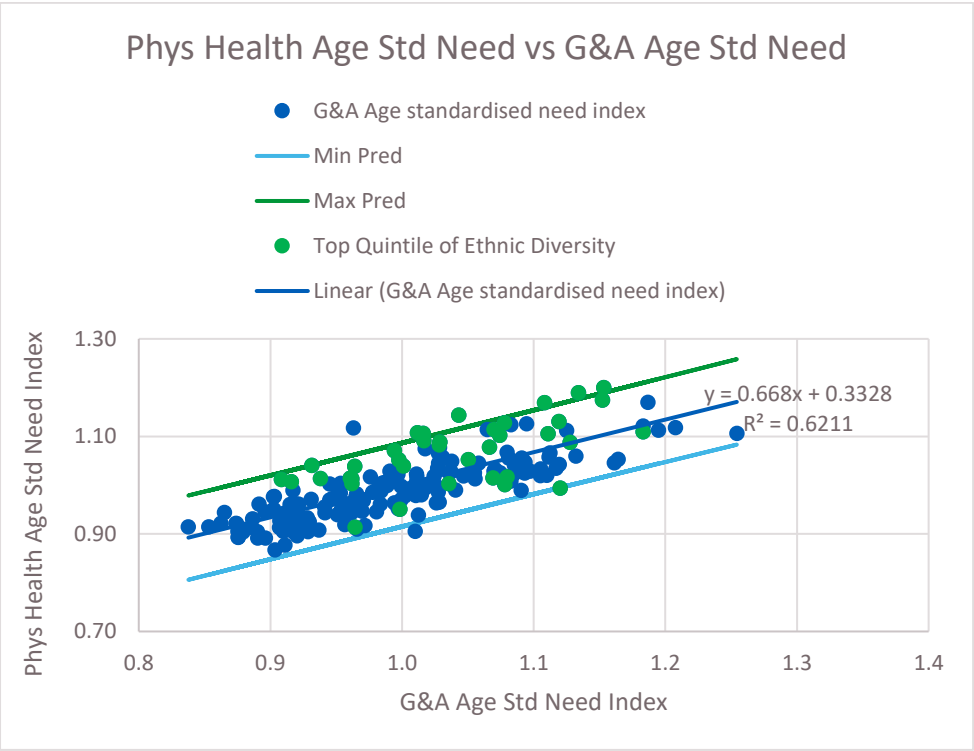
		Specialised Services Model						General and Acute Model					
		Age quintile (A1 = youngest quintile, A5 = oldest quintile)						**Age quintile** (A1 = youngest quintile, A5 = oldest quintile)					
		A1	A2	A3	A4	A5		A1	A2	A3	A4	A5	
Deprivation quintile (D1 = least deprived, D5 = most deprived)	D1	0.65	0.86	0.95	1.02	1.12	1.01	*0.60*	*0.80*	*0.90*	*0.99*	*1.10*	*0.96*
	D2	0.63	0.90	0.99	1.06	1.16	1.02	*0.61*	*0.86*	*0.97*	*1.05*	*1.15*	*1.00*
	D3	0.71	0.93	1.02	1.09	1.20	0.99	*0.69*	*0.92*	*1.04*	*1.12*	*1.22*	*1.00*
	D4	0.80	0.97	1.06	1.12	1.21	0.98	*0.76*	*0.98*	*1.10*	*1.18*	*1.26*	*1.00*
	D5	0.87	1.01	1.09	1.16	1.28	1.01	*0.86*	*1.07*	*1.18*	*1.24*	*1.42*	*1.06*
		0.77	0.95	1.02	1.07	1.16		*0.74*	*0.95*	*1.03*	*1.08*	*1.16*	

The age gradient for specialised services is exaggerated by the omission, for the reasons given above, of HIV and NCC services from the model.

The correlation of specialised services need with deprivation is also apparent in the following chart, which shows CCGs ordered from least to most deprived on the X-axis and their age-sex-standardised PSS need index (using the aggregate model excluding NCC and HIV) on the y-axis. About a third of the variation in age-sex-standardised need is shown to be associated with deprivation. Some of the remaining variation is associated with ethnicity: ethnically diverse CCGs (picked out in green) tend to have higher levels of estimated need.



The limited correlation with the needs indices for general and acute services is shown in the following chart, which plots non-specialised (G&A) need against specialised need, all age-sex standardised. Nearly two-fifths of the variation in need for specialised services at CCG level is uncorrelated with variation in non-specialised. Again, ethnically diverse CCGs (shown in green) have higher levels of specialised need.



2.7.5 Relative need for different services

To understand better the service-components of the need for specialised services that we are modelling, four indicative sub-models are being created. These models will not be used for allocating funds for these services to ICSs but may be of use to commissioners in benchmarking their expenditure on the different services, and in understanding their overall target allocation relative to baseline expenditure.

For these sub-models, the same overall approach is taken, but instead of modelling the factors that determine individuals' utilisation of physical health services overall (with the exceptions noted), we seek to understand what drives utilisation respectively of:

- cancer services
- cardiac services
- renal services
- neurosurgery services.

2.7.6 Projecting target allocations for future years

The needs indices for specialised services are derived from the model using needs-variables from the base years of 2016/17 and 2017/18 to predict utilisation of specialised services in the fiscal year 2018/19, as described above.

The model will be re-run with the same specification but with the base year variables from 2017/18 and 2018/19 targeted on actual utilisation in fiscal year 2019/20. This will deliver revised estimates of the relative need for specialised services of each age-sex cohort of each GP practice in the country. These can then be applied to 2019/20 populations and aggregated to create revised ICS relative needs indices.

They can also be applied forward to the populations projected for each forward year in the allocation using population projections published by ONS. This relies on our ability to project populations forward. It also assumes that a reasonable predictor of relative need in the forward year is the relative need of a given age-sex cohort in the same GP practice in the modelled year. This assumption is validated through comparison of needs indices between the 2018/19 and the 2019/20 model (see forward work programme, section 3.1, i); early results from the 2019/20 modelling are encouraging.

2.8 HIV and NCC model adjustments

2.8.1 HIV

HIV services could not be included in the aggregate physical health model because, for reasons of confidentiality, information about the personal diagnostic history could not be linked to information about utilisation of these services (even in pseudonymised form).

HIV services represent around 3½ % of specialised physical health services total spending (excluding highly specialised services), and the geographical distribution of need for this service is unlikely to match that of other specialised services. It is therefore necessary to construct a separate model of the likely pattern of need for HIV services and to use that to make an adjustment to the target allocation for physical health services in aggregate.

An alternative approach would have been to exclude HIV from the needs-based allocation, continuing to allocate these services on the basis of historical funding. However, the historical development of payment locally to provide for these services, as for other specialised services, has been subject to myriad influences that may have led to funding and access to services that does not equitably reflect the characteristics of local populations.

The dataset from Public Health England we have used to develop the HIV adjustment suggests that some 95% of the variation in spend on HIV by ICS-population is explained simply by variation in the number of patients.

So, our proposed approach is to adjust the fair-shares allocation by taking the segment of spend on HIV and allocating it notionally to ICSs pro rata to the distribution of the 85,143 patients (adjusting for MFF).

In theory, a more complex model could be created, one that allows for age, sex, co-morbidities, cultural variation, ethnicity effects, etc. In practice, this is not possible given the interdiction on establishing person-level data linkage. What may be possible is to introduce adjustments for the proportions of new and of complex patients in each area. On current data, variation in commissioner cost per patient is not explained by the proportions of ‘new’ or ‘complex’ patients. Such a refinement may be considered again later with more years’ data, or with bottom-up costing estimation.

There is attraction in the simplicity of a notional allocation based entirely on a patient count. Variation in expenditure from HIV need estimated in this way is entirely

attributable to variation in HIV spending per person with HIV. As this does not seem to be accounted for by variation in case-complexity, it is plausibly related either to variation in pathway design and efficiency, or to variation in the scope of services funded directly by NHS England (i.e. variation in the funding boundary with CCGs and Local Authorities). Neither should be taken into account in the needs-based target allocation. (The calculations do take account of variation in unavoidable costs due to location, the MFF.)

ACRA supports this simple approach to creating an HIV adjustment to the target needs indices for specialised physical health services.

The greater challenge relates to the modelling and funding of patients who are not in touch with HIV services. This is being investigated as part of the work on the unmet need health inequalities/unmet need adjustment to target allocations described above (section 1.1) and referenced also in the forward work programme (see section 3.1, vii).

2.8.2 Neonatal critical care

Because NCC services are provided for persons who do not have a medical history and have not been born at the start of the target year, they could not be included in the main model of specialised services utilisation, which starts with a list of patients registered to GP practices at the start of the model's target year, and links to each person's medical history to assess need-drivers. So, an off-model adjustment is required.

NCC services represent around 5½ % of specialised physical health services total spending (excluding highly specialised), and the geographical distribution of need for this service is unlikely to match that of other specialised services. It is therefore necessary to construct a separate model of the likely pattern of need for NCC services and to use that to make an adjustment to the target allocation for physical health services in aggregate.

An alternative approach would have been to exclude NCC from the needs-based allocation, continuing to allocate these services on the basis of historical funding. However, the historical development of payment locally to provide for these services, as for other specialised services, has been subject to myriad influences that may have led to funding and access to services that does not equitably reflect the characteristics of local populations.

To model NCC services use, we have developed an area-based model which we describe here in order to give an idea of the likely geographical spread of service need,

and how it differs from other services. We have discussed the area-based approach, and alternative person-based approaches (linking babies to their mothers to provide person-level risk variables), with TAG, and subsequently with ACRA, who have endorsed the approach here described.

For an area-level approach, it is necessary to determine a geographical level of analysis. And we also require a metric of resource use. These are discussed in turn:

a) **Geography**. Candidates for level of granularity include: lower layer super output areas (LSOA), middle layer super output areas (MSOA), each of which describes a geographical patch (of increasing size). There are 32,844 LSOAs in England, with populations averaging around 1,500 and ranging from one to three thousand, and 6,791 MSOAs, which are five times as populous. Modelling records at LSOA level is problematic due to small numbers: on average there are 17 babies born in an LSOA. The analysis was therefore conducted at MSOA.

b) **NCC resource use and cost-weights**. Given the availability of a set of activity categories that are designed to be homogeneous in resource use, the NCC HRGs, it was determined to model cost-weighted resource use rather than expenditure. (Many specialised services lack established HRGs, so the main physical health model uses expenditure; the general and acute model used for allocating non-specialised funding is estimated against cost-weighted activity.) A set of cost-weightings for NCC have been promulgated by NHS Improvement:[15]

HRG	Description	Relative weight
XA01Z	Neonatal Critical Care, Intensive Care	4.0
XA02Z	Neonatal Critical Care, High Dependency	2.0
XA03Z	Neonatal Critical Care, Special Care, without External Carer	1
XA04Z	Neonatal Critical Care, Special Care, with External Carer	0.8
XA05Z	Neonatal Critical Care, Normal Care	0.6

[15] https://www.england.nhs.uk/wp-content/uploads/2020/11/21-22NT_Annex-B-Guidance-on-currencies.pdf

This can be applied to activity data from CCMDS at cot-day level to derive a measure of resource use as cost-weighted activity. This is our dependent variable: the task is then to explain variation in this at MSOA level.

The principal driver for determining need for NCC services is naturally the number of babies born in a period, which prospectively can be taken from ONS projections.

We need also to take account of the risk factors that are known to be associated with recourse to critical care usage, rolling these forward from model year to the target allocations year.

The model we have developed predicts NCC service need in an area on the basis of the number of babies born in the target year modified to allow for the greater likelihood of critical care use in areas with:

a) A higher proportion of births that are either underweight or very underweight (<2000g, <1500g, etc).
b) A higher proportion of births of high-risk gestational length

Deprivation according to IMD sub-domain recording the proportion of children living in the geography who are subject to income deprivation (IDACI) was found significant in some model structures. TAG recommended switching the dependent variable to cost weighted resource use per birth, however, and under this specification deprivation ceased to add explanatory value.

The proportion of low weight births in an area may capture other factors that might contribute to recourse to critical care, such as poor maternal health and smoking during pregnancy, and more generally, deprivation.

Maternal age was not found to be a risk-factor independent of others listed.

CCG supply variables are included in the model and sterilized in derivation of need indices. As in the general and acute model, use of cost-weighted activity as the dependent variable obviates the requirement to include provider-specific supply variables.

56% of the variation in NCC resource use (cost weighted) across MSOA populations, and 92% of the variation across both CCG and ICS populations is explained by a model driven by these factors.

Expenditure that is out of line with model predictions is plausibly related to variation in access thresholds for these services, or to variation in pathway design efficiency, or to variation in local prices that are charged for these services. None of these should be taken into account in the needs-based target allocation.

2.8.3 Modelled need indices for aggregate physical health services adjusted for HIV and NCC

The table below shows the relative need indices by ICS for the aggregate physical health model from section 2.7 alongside the index for HIV and the illustrative index for NCC services, and a full illustrative aggregate index of need incorporating all these services. This is derived by weighting the three indices together according to their expenditure weights in 2018/19. The combined index is illustrative as it mixes 2019/20 indices for NCC and HIV with the 2018/19 need index for other services (as described above); nonetheless it serves to convey the scale and directionality of the NCC and HIV adjustment by ICS.

The needs indices for HIV and NCC respectively will be rolled forward to act as an adjustment to the aggregated model need for other services in each year for which a target allocation is required. Stability of the geographical distribution and the overall weight of NCC need and HIV need among specialised physical health services is a formal assumption according to ACRA's usual practice; no forecast of relative need for these services relative to other specialised services is implied.

Modelled Relative Need for Specialised Services Excluding HSS, CDF by STP in 2018/19, adjusted for estimated needs indices for HIV, NCC 2019/20

		Weighting	*0.911*	*0.035*	*0.054*	
STP19 (42) Sustainability and Transformation Partnerships	**Region19 (7)**	**STP**	***PSS Need Index excl. HIV, NCC***	***HIV Need Index***	***NCC Need Index***	**Aggregated PSS Need Index**
East London Health & Care Partnership (STP)	London	QMF	*0.890*	*2.420*	*1.349*	**0.97**
North London Partners in Health & Care (STP)	London	QMJ	*0.917*	*2.673*	*1.035*	**0.98**
North West London Health & Care Partnership (STP)	London	QRV	*0.881*	*2.523*	*1.160*	**0.95**
Our Healthier South East London STP	London	QKK	*0.899*	*3.585*	*1.150*	**1.01**
South West London Health & Care Partnership (STP)	London	QWE	*0.877*	*1.868*	*1.062*	**0.92**
Bath and North East Somerset, Swindon and Wiltshire STP	South West	QOX	*1.003*	*0.438*	*0.839*	**0.97**
Bristol, North Somerset and South Gloucestershire STP	South West	QUY	*0.989*	*0.700*	*1.004*	**0.98**
Cornwall & Isles of Scilly H&SC Partnership (STP)	South West	QT6	*1.291*	*0.345*	*0.760*	**1.23**
Devon STP	South West	QJK	*1.134*	*0.469*	*0.843*	**1.09**
Dorset STP	South West	QVV	*1.125*	*0.744*	*0.626*	**1.08**
Gloucestershire STP	South West	QR1	*0.987*	*0.462*	*0.845*	**0.96**
Somerset STP	South West	QSL	*1.125*	*0.355*	*0.826*	**1.08**
Buckinghamshire, Oxfordshire and Berkshire West STP	South East	QU9	*0.889*	*0.599*	*0.890*	**0.88**
Frimley Health & Care ICS (STP)	South East	QNQ	*0.879*	*0.801*	*1.033*	**0.88**
Hampshire and the Isle of Wight STP	South East	QRL	*0.990*	*0.553*	*0.925*	**0.97**
Kent and Medway STP	South East	QKS	*0.990*	*0.561*	*1.188*	**0.99**
Surrey Heartlands Health & Care Partnership (STP)	South East	QXU	*0.960*	*0.635*	*0.949*	**0.95**
Sussex and East Surrey STP	South East	QNX	*1.005*	*1.300*	*0.790*	**1.00**
Birmingham and Solihull STP	Midlands	QHL	*0.940*	*0.949*	*1.179*	**0.95**
Coventry and Warwickshire STP	Midlands	QWU	*0.965*	*0.915*	*0.997*	**0.97**
Herefordshire and Worcestershire STP	Midlands	QGH	*1.039*	*0.328*	*0.690*	**1.00**
Joined Up Care Derbyshire STP	Midlands	QJ2	*1.050*	*0.497*	*0.820*	**1.02**
Leicester, Leicestershire and Rutland STP	Midlands	QK1	*0.915*	*0.867*	*0.808*	**0.91**
Lincolnshire STP	Midlands	QJM	*1.040*	*0.350*	*0.781*	**1.00**
Northamptonshire STP	Midlands	QPM	*0.973*	*0.944*	*0.991*	**0.97**
Nottingham and Nottinghamshire Health and Care STP	Midlands	QT1	*1.025*	*0.754*	*0.897*	**1.01**
Shropshire and Telford and Wrekin STP	Midlands	QOC	*1.094*	*0.380*	*1.004*	**1.06**
Staffordshire and Stoke on Trent STP	Midlands	QNC	*1.072*	*0.468*	*0.983*	**1.05**
The Black Country and West Birmingham STP	Midlands	QUA	*0.989*	*1.132*	*1.081*	**1.00**
Bedfordshire, Luton and Milton Keynes STP	East of England	QHG	*0.962*	*1.205*	*1.919*	**1.02**
Cambridgeshire and Peterborough STP	East of England	QUE	*0.899*	*0.655*	*1.078*	**0.90**
Hertfordshire and West Essex STP	East of England	QM7	*0.971*	*0.733*	*0.930*	**0.96**
Mid and South Essex STP	East of England	QH8	*1.022*	*0.674*	*1.048*	**1.01**
Norfolk and Waveney Health & Care Partnership (STP)	East of England	QMM	*1.115*	*0.794*	*0.986*	**1.10**
Suffolk and North East Essex STP	East of England	QJG	*1.086*	*0.500*	*0.919*	**1.06**
Cheshire and Merseyside STP	North West	QYG	*1.091*	*0.550*	*0.791*	**1.06**
Greater Manchester H&SC Partnership (STP)	North West	QOP	*1.025*	*1.330*	*1.154*	**1.04**
Healthier Lancashire and South Cumbria STP	North West	QE1	*1.160*	*0.726*	*0.860*	**1.13**
Cumbria and North East STP	N E and Yorkshire	QHM	*1.074*	*0.489*	*0.909*	**1.04**
Humber, Coast and Vale STP	N E and Yorkshire	QOQ	*1.038*	*0.344*	*0.946*	**1.01**
South Yorkshire and Bassetlaw STP	N E and Yorkshire	QF7	*1.051*	*0.629*	*1.003*	**1.03**
West Yorkshire and Harrogate (H&C Partnership) STP	N E and Yorkshire	QWO	*0.962*	*0.746*	*1.151*	**0.96**

3. Forward work programme

3.1 Improving the model

The development of needs-based allocations for specialised services will continue to be required for so long as accountability for achieving value for these services is separated from that for other services. Work to improve estimation of need may, subject to feedback on this engagement, include the following elements:

i. **Assess stability for projection of relative need.** Setting target relative-need allocations for future years involves an assumption of stability of need that should be tested. Specifically, once a model is selected, it will be used to create a relative need-weight for each age-sex cohort in each GP practice in 2019/20; this is on the basis of diagnostic history and other need variables occurrent in the previous two years. These need-weights are then projected forward for several years to determine target allocations, on the assumption that relative need for a given age-sex cohort is stable over that period. We are testing this stability for a one-year projection, as we rerun the model (currently targeted on 2018/19 utilisation) with 2019/20 set as the Target Year. Early results suggest stability of the specialised services model between 2018/19 and the 2019/20, giving a positive answer to the question, “Is the level of need attributed to ICSs sufficiently stable from year to year to form the basis for forward allocations at ICS level?”

ii. **Check robustness of service weighting,** testing whether the model methodology adequately allows for the variation, service by service, in the coverage of the PLCM. Variation in PLCM coverage of different services might introduce a bias in the estimation of need if for example a service with relatively low coverage is more prevalent in a particular age group than other services, in which case we may be underweighting that age group in the estimate of need. The work will have to take into account uncertainty as to whether underrepresentation in the PLCM relates to patient numbers (in which case an adjustment would be needed to add more patients, with their costs), or whether for some services the quantum of expenditure for the patients captured is understated (in which case an adjustment would be focused on the implicit cost-per-patient).

iii. **Review diagnostic categories**, including the option of designing them more closely around rules identifying specialised spending, taking a view service by service of the trade-off between increased precision in identifying enduring specialised need, and avoiding inclusion of supply effects where specific diagnoses are more likely to be given by specialised providers. This will include consideration of use of clinical registry data to capture information about patients, such as those with congenital heart conditions or hepatitis C, whose care is predominantly provided out of hospital, and whose diagnostic history may therefore be missing from the inpatient dataset relied on in the model.

iv. **Allow for diseconomies of small scale.** Investigate diseconomies of small scale in the provision of specialised services where there is a clinical necessity for providing services close to patients' homes in remote areas, considering in particular neonatal services, radiotherapy; and rural and coastal areas (as referenced by CMO's report on Coastal Communities).[16] Work would be required to apply the approach developed in ACRA(2021)16, which found economies of scale in department size (mitigated by diseconomies of scale by site and provider), to specialised services. In the first instance, we can investigate whether coastal patients appear to incur systematically higher costs of treatment.

v. **Explore alternative model structure.** Investigate alternative model structures, in particular models that distinguish estimation of likelihood of requiring specialised services from estimation of the expected cost of such services if required. This should enable model predictions of the numbers of patients separately from predictions of the cost per patient – which would support better understanding of divergence between actual and modelled resource use ('distance from target').

vi. **Determine the model's sensitivity to the healthcare burden of disadvantage.** Detail and quantify the extent to which service costs are greater in serving disadvantaged communities (through engagement with clinicians and commissioners of services, and literature review), and explore whether such costs flow through into the PLCM and therefore are likely to be captured by deprivation variables in the model, and if not what adjustment is required.

[16] https://www.gov.uk/government/publications/chief-medical-officers-annual-report-2021-health-in-coastal-communities

vii. **Assess extent of undiagnosed need.** Work in parallel with the NIHR unmet need project to assess the extent of need for specific specialised services that is not captured by the diagnosis variables in the model. This work-strand is linked to the review of diagnostic categories, mentioned above. This work necessarily focuses on services for which a methodology is available: for example, undiagnosed need for cancer services is revealed by late-stage presentation.

3.2 Variations analysis to support benchmarking of services

NHS England intends to undertake detailed work to understand, ICS by ICS, and if possible, place by place and service by service, what is responsible for the distance between actual expenditure on specialised services and target allocations: i.e. the variation between actual resource utilisation and modelled need for specialised services.

The motivation for this work is three-fold:

- as a test of the model of need described above and of proposals on its basis to move over time towards needs-based allocation: we will be much more confident that we are driving towards fairer allocations if we can build shared understanding with local systems of what it is that explains variation of resource use relative to the model, answering the questions respectively – on what extra money is spent, and what are the patient consequences of shortfall of resource use relative to modelled need
- as a determinant of the pace of convergence towards needs-based allocations: pace of convergence should be determined by the feasibility of strategies to bring resource use into line with the needs-based target allocation, and these in turn require understanding of what is driving variation. (Where variation in resource utilisation relative to need is positively linked to quality of service and outcomes, the aim would be to use growth funding to enable other areas to level up.)
- as a support for local systems seeking to bring resource utilisation in line with modelled need through benchmarking of their service provision against others with similar need but different levels of resource use. The aim would be to encourage ICBs to recognise that pace of convergence will be slow enough to enable them to adjust services in good time; to think strategically rather than transactionally about the introduction of a gradual transition towards needs-based allocations.

Variations/efficiency analysis will therefore be integrated into the programme to support the move over time towards target needs-based allocations.

Analyses will be conducted along the following dimensions:

- by smaller populations: focusing on place – however that is defined (so long as it can be built up from GP-practices)
- separating services: initially focusing on four major service areas – cancer, renal, cardiac and neuroscience services, for each of which an indicative needs-based allocation is being produced
- for each service and for the aggregate model (at ICS and place), distinguishing as far as the data allows between the following components of variation:
  - scope of services (where, due to differences of implementation of the identification rules (the IR) determining what services are classified as PSSs, the scope of services funded by specialised commissioning varies)
  - access to services – considering variation in the number of patients treated per head of population, which may be attributable for example to differences in access related to referral-distance or to differences in eligibility thresholds
  - variation in utilisation of specialised services attributable to differences in effectiveness of upstream services. This assessment will triangulate with RightCare and GIRFT analyses, and with variation in use of upstream services relative to modelled need for general and acute services, etc.
  - efficiency – variation in costs per patients not associated with variation in outcomes. This strand will bring a provider perspective to bear, including triangulating with Model System, GIRFT, assessing the extent to which service-provision from particular providers tends to increase population health costs
  - variation in outcomes: at least as a control analysis, we would wish to see whether variation in resource use relative to the model is associated with variation in such outcome measures as standardised mortality rates.

To support benchmarking, ICSs and places will be grouped by the modelling into peer-groupings according to the modelled-needs of their population. We will aim to support ICSs seeking to understand each dimension of variation in which analysis shows opportunity for improvement.

4. Next steps

ACRA believes that the changes outlined in this document represent significant improvements compared to the current approaches for estimating need for specialised services, consistent with their criteria for assessing model changes.

Nevertheless, ACRA would welcome the opportunity to contribute to further development of this model should there be significant feedback on any aspect of the model.

A summary of the responses to the engagement, and ACRA's response to the points raised, will be published as part of the technical guide to allocations.

Specific issues on which feedback is sought are as follows:

i. Do you agree that the methodology adopted for needs-based allocation for specialised services should parallel that long-developed for CCG-funded services as far as the data allows?

ii. Do you agree that the approach taken to modelling specialised need, as set out above, including the adjustments for HIV and NCC services, provides a sound basis for setting target allocations at the current time? Please give reasons.

iii. Do you agree with the forward work programme proposed in section 3.1 to refine the model over time? Please comment on their relative priority.

iv. Do you agree with the proposed forward work programme to undertake variations analysis to support benchmarking of services set out in section 3.2? Please comment.

v. Are there other issues that you believe should be addressed by the forward work programme?

Feedback can be made by 30th June 2022 by email to england.revenue-allocations@nhs.net

Annex A: ACRA membership

Prof Peter Smith – Chair	Emeritus Professor of Health Policy, Imperial College Business School
Dr Sheena Asthana	Professor of Health Policy, School of Law, Criminology and Government, University of Plymouth
Dr Chris Bentley	HINST Associates
Bob Butcher*	Deputy Director, Care and Transformation Directorate, Department of Health
Ben Chilcott	Deputy Director of Finance, NHS Devon CCG
Prof Richard Cookson	Centre for Health Economics, University of York
Dr Mike D'Souza	GP, Kingston Multi-fund GP consortium (Former)
Kerstin Parker*	Head of Financial Strategy and Allocations, NHS England,
Dr Heather Ross*	Senior Analytical Lead for Allocations, Analysis and Insight for Finance, NHS England
Shaun Donaghy*	Chief Economist, Office for Health Improvement and Disparities
Dr Sunil Gupta	GP and Member of the Governing Body of Castlepoint and Rochford CCG
Prof Sir Brian Jarman	Emeritus Professor of Primary Care, Imperial College of Medicine
Tarryn Lake	Associate Director of Finance, NHS Sunderland CCG
Andrew Lloyd-Kendall	Head of Research, Public Health and Healthcare, BMA
Dr Stephen Lorrimer*	Head of Analysis and Insight for Finance, NHS England
Prof Eugene Milne	Director of Public Health, Newcastle City Council
Nicola Morton	Head of Local Government Finance, Local Government Association
Dave Roberts	Head of Primary Care Information, NHS Digital
Prof Colin Sanderson	Professor of Operational Research in Health Care, London School of Hygiene and Tropical Medicine
Rob Shaw	Head of Forecasting, Data and Analytics, NHS England
Steve Smallwood	Head of Population Statistics Transformation Unit, Office for National Statistics
Prof Matt Sutton	Professor of Health Economics, University of Manchester
Dr Ian Trimble	Independent GP Adviser, NHS Rushcliffe CCG

*Organisation-specific members

Annex B: (i) ACRA commissioning letter and (ii) ACRA letter of recommendations

(i) ACRA Commissioning Letter, June 2019

Julian Kelly
Chief Financial Officer
NHS England
Skipton House
80 London Road
London
SE1 6LH

To: Peter Smith,
Chair of Advisory Committee on Resource Allocation (ACRA)
Emeritus Professor of Health Policy, Imperial College London

Dear Professor Smith,

Commissioning Letter for Advisory Committee on Resource Allocation

I would like to express my gratitude for the contribution of ACRA to the update of the CCG allocation formula. The important progress the Committee made in the refresh of the mental health and learning disabilities model, the development of the community services model, changes to the baseline and projected populations and updating the methodology used in the combined health inequalities and unmet need adjustment have improved the quality of the analysis that underpins the production of target allocations.

ACRA's advice and the refreshed formulae were critical contributors to NHS England issuing firm allocations for 2019-20 to 2021-22 and indicative allocations for 2022-23 and 2023-24.

The work programme for the next two years will build on that recent progress with a focus on updating the general and acute and specialised services models, development of a patient-level prescribing model and a review of the rurality adjustments. In addition, a key area for development for the next round of allocations will be the health

inequalities and unmet need adjustment. In recognition of ACRA's contribution in this area and as stated in paragraph 2.25 of the Long Term Plan, NHS England and Improvement commission ACRA to conduct and publish a review of the inequalities adjustment in the funding formula. Simon, my Board colleagues and I look forward to receiving ACRA's recommendations for firm allocations from 2022-23.

I would like to take this opportunity to thank you, the members of ACRA and the Technical Advisory Committee for your valuable work in making independent expert recommendations in the important area of health allocations.

Yours sincerely,

(ii) ACRA Letter of Recommendations, November 2021

Amanda Pritchard
Chief Executive, NHS England

Dear Amanda,

ACRA's recommendations on 2022/23 ICS target allocations

The Advisory Committee on Resource Allocation (ACRA) is an independent, expert committee with a remit to provide recommendations and advice on the formulae that inform target budgetary allocations for local commissioners of health services. Our remit covers providing recommendations to NHS England on NHS allocations and to the Secretary of State for Health on public health allocations.

I am writing to you to set out the recommendations from ACRA on Integrated Care System (ICS) target allocations for 2022/23 onwards. These recommendations are the culmination of the Committee's work programme over the past three years. During that time, the Committee has also separately provided advice to the Department of Health and Social Care on public health allocations.

Below, in section A, I set out the areas on which the Committee has agreed to make formal recommendations. For completeness, the components of allocations where new recommendations have not been made are then listed in section B. I then provide a brief summary of our suggested priorities for investigation into methodological improvements for the next round of allocations in section C, concluding with broader recommendations that the committee would like to make in support of high-quality approaches to allocations in future.

Our recommendations continue to be based on the principles that the formulae support equal opportunity of access for equal need and contribute to the reduction in avoidable health inequalities. ACRA continues to assess and test the evidence base for the formulae, making our recommendations on the best evidence available, and also noting when judgements have necessarily been made where the available data are limited.

I should like to thank members of ACRA, members of ACRA's Technical Advisory Group (TAG), members of the Health Inequalities Task and Finish Group (HITFG) and the NHS England Analysis and Insight for Finance Team for all their contributions to delivering the work programme.

Section A: ACRA's recommendations for methodological changes to 2022/23 ICS target allocations

The committee would like to make the following recommendations on five key components of ICS target allocations methodology, compared to the methodology last used for the 2018/19 CCG allocations round.

Recommendation 1: A refreshed model for general and acute hospital services is adopted

The current general and acute services model was first introduced in 2016/17 having been developed in 2015. In refreshing the formula, we have adopted a similar methodology ("Person Based Resource Allocation", PBRA) and re-estimated the models using more recent data. The data used in the model are from before the start of the COVID-19 pandemic. An extensive set of explanatory variables have been tested in the model. The committee has also considered changes to the model specification and has selected the model that provides the best fit to the data while also being parsimonious and stable when applied to different samples of data.

Our recommended model contains a set of need variables based on demographic information about the local population (age, sex, and ethnicity), household formation, indicators of deprivation and relevant morbidity information based on hospital diagnoses. It also contains a set of supply-side variables to control for varying levels of access around the country, varying approaches to the provision of care and varying practices amongst providers in recording activity.

Recommendation 2: A new model for specialised services is adopted

The current specialised services model was developed for the first time for 2016/17 allocations. These allocations were indicative and were not used to distribute specialised services resources. The model covered less than 50% of specialised services spend with remaining spend targeted in line with historic spending patterns. The committee was asked to advise and make recommendations on an updated model that would support increased delegation of resources to ICSs from 2023/24.

Our recommended model utilises an alternative dataset (the Patient Level Contract Monitoring dataset rather the Secondary Uses Service data) that has enabled model coverage to be extended to over 90% of specialised services spend (excluding highly specialised services and specialised mental health services). The model includes a set of need variables based on demographic information about the local population (age, sex, and ethnicity), household formation, benefit entitlement, and relevant morbidity information based on coding by hospitals. It also contains a set of supply-side variables and a set of provider variables that have been developed to account for variations in provider efficiency and service delivery practices.

The committee would welcome the opportunity to contribute to further development of this model should there be significant feedback between now and implementation in 2023/24.

Recommendation 3: An update is made to the measure used in the combined adjustment for health inequalities and unmet need

The health inequalities and unmet need adjustment is currently based on a measure of premature mortality – the standardised mortality ratio for those aged under 75 (SMR<75). These data are available at a small area level and thus allow the adjustment to reflect inequalities within as well as between CCGs. To form the adjustment, a weighting is applied to the standardised mortality ratio of each small area before the results are aggregated to CCG level. The methodology is readily adapted to accommodate the new arrangements based on ICSs.

As part of ACRA's review into the health inequalities adjustment, commissioned in the NHS Long term plan, the committee has considered alternative measures that could be used to calculate the adjustment. We have concluded that the metric used to calculate the adjustment should be changed to a measure of avoidable mortality; this was the only other measure to pass all of the review's criteria and is considered a better fit to the definition of health inequalities than SMR<75 as the causes of death included have been identified as those that could have been avoided through public health measures and/or timely and effective health care intervention. In contrast, the SMR<75 includes deaths from all causes and excludes all deaths, no matter what the cause, for those aged over 75 years. The committee is not recommending any other change to the way the adjustment is calculated.

The impact of this adjustment depends on the weighting of the inequalities component within overall target allocations. ACRA has previously been asked to advise on that weighting, but there has been a lack of evidence on which ACRA can make a recommendation. As part of the health inequalities review the committee have attempted to gather evidence from CCGs that would provide an evidence base for this decision. As CCGs do not map their expenditure in a way that could robustly identify spend on health inequalities the committee is not in a position to make a recommendation on the weights and this remains a matter for the NHS England Board.

A National Institute for Health Research (NIHR) funded project is currently underway to consider alternative methods of adjusting for unmet need within allocations; unmet need is currently included as part of the health inequalities adjustment. This project has been delayed but is expected to report during 2023. Until the completion of this project the committee is not recommending any changes to how adjustments are made for unmet need.

Recommendation 4: Baseline populations are estimated using GP registrations for a single month

For the previous round of allocations ACRA recommended a change to use a 12-month average of GP registrations as the baseline population. This was to account for seasonality in the size of registered populations for some CCGs. The COVID-19

pandemic has had an impact on the size and relative distribution of the GP registered population. For the period April to June 2020 there was an unprecedented fall in GP registrations. Although the number of registered patients has now begun to rise, the levels of growth have been lower than previous trends. To minimise the impact on allocations of these changing patterns of GP registration, the committee is recommending that a single month is used as the baseline population rather than a 12-month average. This is recommended for this round of allocations only, with the expectation that the 12-month average population will be used for future allocation rounds once registered populations have stabilised.

Recommendation 5: The costs of providing services in unavoidably small hospitals are updated

Updated modelling has been undertaken to consider the additional costs for small hospitals that are unable to operate at an efficient scale and are remote from other providers of Type 1 A&E services. This adjustment will continue to be applied to the hospitals that have been identified as being unavoidably small due to remoteness.

Section B: Issues that are not part of this set of recommendations

We recommend that the remaining components of CCG target allocations that are not covered in section A above are modelled as in previous rounds, where appropriate using updated data. These components are the mental health formula, the community services formula, the prescribing formula, the maternity formula and the primary medical care formula.

Section C: Our priorities for methodological improvements for the next round of allocations

We are confident the recommendations resulting from our work programme over the past three years will improve the efficiency and equity of the target allocation formulae. The committee has identified several areas it believes should be considered in future allocation rounds. The committee recognises that the development of models in this work programme will be impacted both by the COVID-19 pandemic and system reform. The priorities for development will need to be informed by the extent to which both data and patterns of utilisation have been impacted by COVID-19 and will need to be responsive to the changes brought about by system working. The areas considered to be priorities for development are:

1. **Mental Health**: Since the development of the mental health model for 2019/20 allocations the quality and quantity of data relating to mental health has improved as mental health providers have been challenged to improve their recording and submission to mandatory data collections, in particular the Mental Health Services dataset (MHSDS). Our work on the review of health inequalities has also highlighted that, given the significant variations in levels of access to mental health services, varying levels of unmet need and challenges in finding data that are suitable for a health inequalities adjustment for these services, there could be merit in exploring alternatives to a utilisation based approach for mental health.

2. **Community Services:** Time, resource and data limitations have meant that the travel time adjustment for community services was not recommended for implementation in 2022/23. Further work on this adjustment is warranted, alongside consideration of whether the quality and consistency of data for community services has improved to the extent that this model could be further developed.

3. **Health inequalities and unmet need**: A National Institute for Health Research (NIHR) commissioned project on unmet need is considering alternative methods for accounting for unmet need in allocations and is due to conclude in 2023. The committee will need to consider the outputs of the research and make recommendations regarding implementation. The ACRA report for the review of the health inequalities adjustment also sets out a range of recommendations for further work. Any further work on health inequalities will also have to take account of the outputs of the NIHR unmet need project and the subsequent separation of unmet need and health inequalities adjustment that may be necessary.

4. **Ethnicity**: Additional cross-cutting work is warranted on how ethnicity is accounted for in our utilisation models. Additional evidence should be sought to determine the extent to which the health outcomes of specific ethnic groups vary from White British groups. This work would need to be supported by improved individual data relating to ethnicity through the ability to link data on individual characteristics to utilisation data.

Section D: Two concluding recommendations

I should like to conclude by making two broader recommendations that the committee is unanimous in believing would make a significant impact on the service's ability to support fair and efficient resource allocation in future.

The first is that **a high priority is given to maintaining and enhancing the accuracy of GP registered lists.** These are fundamental to allocations, being the key driver of the distribution of resources to different parts of the country, and any loss of trust in the quality of lists presents a threat to the credibility of the allocations process as a whole.

The second recommendation is that **access to high quality patient level data should continue to be developed and progressed.** From the ACRA perspective there are four key issues.

First, irrespective of how pricing and contracting arrangements develop over time, there should be a duty on providers to record accurate information on what services are being provided to whom, in order to support a host of policy, managerial and research needs, including resource allocation. It is essential that high quality patient level data are available from all providers, including mental health providers, and both NHS and non-NHS providers of community services. Improved quality and consistency of patient level data for community and mental health services will be crucial for enhancing the needs-based models for these services.

Second, providers and commissioners should recognise the importance of accurate coding of diagnoses. The development of the general and acute model has demonstrated the impact that, for instance, the depth of coding can have on allocations and the distribution of resources. Any drop in the quality of recording of diagnostic information will affect the ability to accurately model need and so have an adverse impact on the robustness of the target allocations. The recording of diagnoses is also important for mental health providers. In previous work we identified significant inconsistency between providers in their recording of mental health diagnoses and clusters (with some capturing up to 90% of patients and some less than 10%), meaning that we could not use those data to enhance the mental health needs model.

Third, recent improvements in the recording of patient characteristics such as ethnicity, necessitated by the COVID-19 pandemic, should also be fed through to the patient level datasets to improve the way that such characteristics are accounted for in our models.

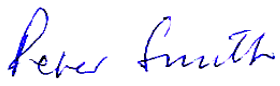
Alongside a focus on high quality data recording, we ask that efforts are redoubled to assure the public of the protection of their data, and to maximise completeness of datasets, whilst ensuring continued access to high quality, patient level linked datasets for NHS analysts and researchers. The future effectiveness of our allocation formulae will be critically dependent on having in place an information governance framework that minimises barriers to the sharing of suitably anonymised data in secure settings. To support this the public needs to be assured that allowing access to their data is safe and will contribute to a better, fairer NHS.

In this regard, we would particularly emphasise the importance of successfully delivering NHS Digital's plans for the new GP Data for Planning and Research (GPDPR) dataset that can be connected to secondary data. To allow analysts to measure resources and impacts for patients through primary care into secondary and tertiary settings would represent a major step forward, especially if it can draw in information from non-health datasets - such as on social care and on income, wealth, employment and interactions with the welfare system.

We hope that our recommendations are helpful to the decisions that the NHS England Board needs to make on ICS allocations. I should be happy to discuss further with you if you would find this helpful.

I am copying this letter to the Secretary of State for Health and Social Care, for information.

Yours sincerely,



Peter Smith
Emeritus Professor of Health Policy, Imperial College London
Emeritus Professor of Health Economics, University of York
Chair of the Advisory Committee on Resource Allocation

cc Secretary of State, DHSC; CFO, NHS England & NHS Improvement

Annex C: Variables tested in the model

The variables tested in the model are those that emerge following a process of variable reduction using principal component analysis (PCA).

There are a great many candidates for the attributed need variables, which makes it difficult to model the impact of each one on specialised services utilisation. To reduce the size of the dataset to subject to econometric modelling, we use PCA. The use of PCA for feature selection was therefore done in advance of the econometric modelling. For the specialised services model described here, the PCA approach reduced the number of attributed need variables by 72 variables, leaving 33 need variables and 19 supply variables (as set out below).

Note that further reductions in the size of the dataset are achieved through the econometric modelling itself, by analysis of the statistical significance of model coefficients, as described in section 2.6.3 of the main paper. The final model retained just one of these candidate variables and two other attributed need variables that had not been subject to PCA (see Annex E for the full list of variables included in the final model).

To conduct the PCA, the attributed variables were split into thematic groups. For each thematic group all possible components were created. The components were retained which, on their own, captured at least 5% of the variance each or cumulatively captured at least 90% of the variance, whichever condition is met first. In other words, adding components until either reaching 90% or until the next component will account for less than 5%.

From these principal components, variables from the original group were then selected based on their loading in the components. If the original group contained more than ten variables, the three most important variables from the first principal component were selected, two variables from the second principal component and one variable from each subsequent component. For thematic groups with ten or fewer variables, the two most important variables were selected from the first principal component and one variable from each subsequent component. If any variable from the subsequent principal

component had already been selected, then the next most important variable was considered.

Before performing the PCA on each of the groups of variables, the Kaiser-Meyer-Olkin measure of sampling adequacy was calculated, which characterises the appropriateness of the group to be data-reduced through PCA. For any groups that fail to meet this criterion PCA was not undertaken and all variables of that group were included in the final model.

Ten groups of variables were created as candidates for PCA variable-reduction:

i. QOF prevalence
ii. QOF scores
iii. QOF exception rates
iv. GP immunisation rates
v. Hospital supply variables
vi. Barriers (subset of IMD variables)
vii. Education (subset of IMD and census variables)
viii. Health (subset of IMD and census variables)
ix. Income (subset of IMD and census variables)
x. Living environment (subset of IMD variables).

Of the ten groups, only living environment could not be reduced through PCA.

The full set of variables used in the modelling, including those surviving this PCA process are as follows.

In addition to these variables, modelling also explored the possible significance of two types of supply variables:

- variables representing the quality of primary and secondary care services, in case these systematically influenced recourse to specialised services;
- variables representing the travel times to specialised services centres, in case access variability could be captured by such variables.

In neither case did significant results emerge in a systematic credible way, and the models' ability to explain variation was not enhanced. It is possible however that these effects are captured by the CCG-specific and provider-specific supply variables in the preferred model.

Individual characteristics

Age/sex splines	
Age <1	Age 45-49
Age 1-4	Age 50-54
Age 5-9	Age 55-59
Age 10-14	Age 60-64
Age 15-19	Age 65-69
Age 20-24	Age 70-74
Age 25-29	Age 75-79
Age 30-34	Age 80-84
Age 35-39	Age 85+
Age 40-44	
Household type	
Care home	Single person
Multi-adult (reference group)	Two adult family
Multi-adult-child	Two adults diff gender
Multi-child	Two adults same gender
Other communal	Unknown
Single parent	
Age and household type interactions	
Ethnic group	
White British (reference group)	
White: Irish	Bangladeshi
White: Other White	Chinese
White and Black Caribbean	Other Asian
White and Black African	African
White and Asian	Caribbean
Other Mixed	Other Black
Indian	Any other ethnic group
Pakistani	
Newly registered with a GP practice	**Private care in last two years**

Diagnoses – included as individual diagnostic flags and as morbidity count variables

A00-A09 Intestinal infectious diseases	K65-K67 Diseases of peritoneum
A15-A19 Tuberculosis	K70-K77 Diseases of liver
A20-A49 Certain bacterial diseases	K80-K87 Disorders of gall bladder, biliary tract & pancreas
A50-A64 Infections with predominantly sexual mode of transmission	K90-K93 Other diseases of the digestive system
A65-A79 Other infectious and parasitic disorders	L00-L14 L55-L99 Other infections and disorders of the skin
A80-A89 Viral infections of the central nervous system	L20-L30 Dermatitis and eczema
A90-A99 Arthropod-borne viral fevers & viral haemorrhagic fevers	L40-L45 Papulosquamous disorders (including Psoriasis)
B00-B09 Viral infections characterized by skin & mucous mem. lesns.	L50-L54 Urticaria and erythems

B15-B19 Viral hepatitis	M00-M25 Arthropathies
B20-B24 Human immunodeficiency virus [HIV] disease	M30-M36 Systemic connective tissue disorders
B25-B34 Other viral diseases	M40-M54 Dorsopathies
B35-B49 Mycoses	M60-M79 Soft tissue disorders
B50-B64 Protozoal diseases	M80-M94 Osteopathies and chondropathies
B65-B83 Helminthiases	M95-M99 Other disorders of the musculoskeletal system & conn. tiss.
B85-B99 Other infectious and parasitic diseases	N00-N08, N10-N16 Diseases of the kidney
C00-C14 Malignant neoplasm of liporal cavity and pharynx	N17-N19 Renal failure
C15-C26 Malignant neoplasm of digestive organs	N20-N23 Urolithiasis
C30-C39 Malignant neoplasms of respiratory & intrathoracic organs	N25-N29 Other disorders of kidney & ureter
C40-C41 Malignant neoplasm of bone and articular cartilage	N30-N39 Other diseases of the urinary system
C43-C44 Malignant neoplasms of skin	N40-N51 Diseases of male genital organs
C45-C49 Malignant neoplasms of mesothelial and soft tissue	N60-N64 Disorders of breast
C50 Malignant neoplasm of breast	N70-N77 Inflammatory diseases of female pelvic organs
C51-C58 Malignant neoplasms of female genital organs	N80-N98 Noninflammatory disorders of female genital tract
C60-C63 Malignant neoplasms of male genital organs	N99 Other disorders of the genitourinary system
C64-C68 Malignant neoplasms of urinary tract	O00-O08 Pregnancy with abortive outcome
C69-C72 Malignant neoplasms of eye, brain & other parts of CNS	O10-O75, O85-O92, O94-O99 Complications of labour and delivery
C73-C80, C97 Malignant neoplasm. of thyroid and oth. endo. Glands etc.	O80-O84 Delivery
C81-C96 Malignant neoplasms of lymphoid, haematopoietic & rel. tiss.	P00-P04 Complications of foetus/neonate affected by maternal
D00-D48 In situ & benign neoplasms and others of uncertainty	P05-P96 Other conditions originating in the perinatal period
D50-D64 Anaemias	Q00-Q89 Congenital malformations
D65-D89 Diseases of the blood and blood-forming organs	Q90-Q99 Chromosomal abnormalities
E00-E07 Disorders of thyroid gland	R00-R09 Symptoms & signs inv. the circulatory/respiratory system
E10-E14 Diabetes Mellitus	R10-R19 Symptoms & signs inv. the digestive system & abdomen
E15-E90 Endocrine nutritional and metabolic diseases	R20-R23 Symptoms & signs inv. the skin & subcutaneous tissue
F00-F03 Dementia	R25-R29 Symptoms & signs inv. the nervous & musculoskeletal sys.
F04-F09 Other organic including symptomatic mental disorders	R30-R39 Symptoms & signs involving the urinary system
F10-F19 Mental and behavioural disorders due to psychoactive subst.	R40-R46 Symptoms & signs inv. Cognition, perception etc.
F20-F29 Schizophrenia, schizotypal and delusional disorders	R47-R49 Symptoms & signs inv. speech & voice

F30-F39 Mood [affective] disorders	R50-R68 General symptoms & signs
F40-F69 Neurotic, behavioural & personality disorders	R69 Unknown & unspecified causes of morbidity
F70-F79 Mental retardation	R70-R89 Abnormal findings of bodily fluids or samples without diag.
F80-F99 Other mental and behavioural disorders	R90-R94 Abnormal findings on diagnostic imaging/function studies
G00-G09 Inflammatory diseases of the central nervous system	R95-R99 Ill-defined & unknown causes of mortality
G10-G14, G30-G32 Other degenerative diseases (incl. Alzheimer).	S00-S09 Injuries to the head
G20-G26 Extrapyramidal & movement disorders (incl. Parkinsonism).	S10-S19 Injuries to the neck
G35-G37 Demyelinating diseases (incl Multiple Sclerosis) of the CNS.	S20-S29 Injuries to the thorax
G40-G47 Epilepsy, migraine & other episodic disorders	S30-S39 Injuries to abdomen, lower back, lumbar spine & pelvis
G50-G73 G90-G99 Other diseases & disorders of the nervous syst.	S40-S49 Injuries to the shoulder & upper arm
G80-G83 Cerebral palsy & other paralytic syndromes	S50-S59 Injuries to the elbow & forearm
H00-H06, H15-H22, H30-H36, H43-H59 Other disorders of the eye etc.	S60-S69 Injuries to the wrist & hand
H10-H13 Disorders of conjunctiva (including conjunctivitis)	S70-S79 Injuries to the hip & thigh
H25-H28 Disorders of lens (including cataracts)	S80-S89 Injuries to the knee & lower leg
H40-H42 Glaucoma	S90-S99 Injuries to the ankle & foot
H60-H95 Diseases of the ear and mastoid process	T00-T07 Injuries involving multiple body regions
I00-I09 Rheumatic heart disease	T08-T14 Injuries to unspecified part of trunk limb or body
I10-I15 Hypertensive diseases	T15-T19 Effects of foreign body entering through natural orifice
I20-I25 Ischaemic heart diseases	T20-T32 Burns and corrosions
I26-I28 Pulmonary heart disease & diseases of pulmonary circulation	T33-T35 Frostbite
I30-I52 Other forms of heart disease	T36-T50 Poisonings by drugs medicaments & biological substances
I60-I69 Cerebrovascular diseases	T51-T65 Tox. effcts. of substances. chiefly non-medicinal as to source
I70-I79 Diseases of arteries, arterioles & capillaries	T66-T78 Other and unspecified effects of external causes
I80-I89 Diseases of veins & lymphatic system nec.	T79 Certain early complications of trauma
I95-I99 Other & unspecified disorders of the circulatory system	T80-T88 Complications of surgical & medical care nec.
J00-J06 Acute upper respiratory infections	T90-T98 Sequelae of injuries of poisoning & other consequences
J09-J18 Influenza & pneumonia	VVV
J20-J22 Other acute lower respiratory infections	WWW
J30-J39 Other diseases of upper respiratory tract	XXX
J40-J47 Chronic lower respiratory diseases	YYY

J60-J70 Lung diseases due to external agents	Z00-Z13 Examination and investigation
J80-J99 Other diseases of the respiratory system	Z20-Z29 Potential health hazards related to communicable diseases
K00-K14 Diseases of oral cavity, salivary glands & jaws	Z30-Z39 Health services in circumstances related to reproduction
K20-K31 Diseases of oesophagusstomach & duodenum	Z40-Z54 Persons encountering health services for specific care
K35-K38 Diseases of appendix	Z55-Z65 Potential health hazards reltd. to socioeconomic & psychosoc.l
K40-K46 Hernia	Z70-Z76 Persons encountering health services in other circs.
K50-K52 Noninfective enteritis & colitis	Z80-Z99 Persons with potential health hazards related to family
K55-K64 Other diseases of intestines	U Unclassified

Number of diagnoses

2 diagnoses	7 diagnoses
3 diagnoses	8 diagnoses
4 diagnoses	9 diagnoses
5 diagnoses	10 diagnoses
6 diagnoses	

Co-morbidities

Neoplasms x Certain infectious and parasitic diseases	Certain conditions originating in the perinatal period x Certain infectious and parasitic diseases
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism x Certain infectious and parasitic diseases	Certain conditions originating in the perinatal period x Neoplasms
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism x Neoplasms	Certain conditions originating in the perinatal period x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
Endocrine, nutritional and metabolic diseases x Certain infectious and parasitic diseases	Certain conditions originating in the perinatal period x Endocrine, nutritional and metabolic diseases
Endocrine, nutritional and metabolic diseases x Neoplasms	Certain conditions originating in the perinatal period x Mental and behavioural disorders
Endocrine, nutritional and metabolic diseases x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Certain conditions originating in the perinatal period x Diseases of the nervous system
Mental and behavioural disorders x Certain infectious and parasitic diseases	Certain conditions originating in the perinatal period x Diseases of the eye and adnexa
Mental and behavioural disorders x Neoplasms	Certain conditions originating in the perinatal period x Diseases of the ear and mastoid process

Mental and behavioural disorders x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Certain conditions originating in the perinatal period x Diseases of the circulatory system
Mental and behavioural disorders x Endocrine, nutritional and metabolic diseases	Certain conditions originating in the perinatal period x Diseases of the respiratory system
Diseases of the nervous system x Certain infectious and parasitic diseases	Certain conditions originating in the perinatal period x Diseases of the digestive system
Diseases of the nervous system x Neoplasms	Certain conditions originating in the perinatal period x Diseases of the skin and subcutaneous tissue
Diseases of the nervous system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Certain conditions originating in the perinatal period x Diseases of the musculoskeletal system and connective tissue
Diseases of the nervous system x Endocrine, nutritional and metabolic diseases	Certain conditions originating in the perinatal period x Diseases of the genitourinary system
Diseases of the nervous system x Mental and behavioural disorders	Certain conditions originating in the perinatal period x Pregnancy, childbirth and the puerperium
Diseases of the eye and adnexa x Certain infectious and parasitic diseases	Congenital malformations, deformations and chromosomal abnormalities x Certain infectious and parasitic diseases
Diseases of the eye and adnexa x Neoplasms	Congenital malformations, deformations and chromosomal abnormalities x Neoplasms
Diseases of the eye and adnexa x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
Diseases of the eye and adnexa x Endocrine, nutritional and metabolic diseases	Congenital malformations, deformations and chromosomal abnormalities x Endocrine, nutritional and metabolic diseases
Diseases of the eye and adnexa x Mental and behavioural disorders	Congenital malformations, deformations and chromosomal abnormalities x Mental and behavioural disorders
Diseases of the eye and adnexa x Diseases of the nervous system	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the nervous system
Diseases of the ear and mastoid process x Certain infectious and parasitic diseases	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the eye and adnexa
Diseases of the ear and mastoid process x Neoplasms	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the ear and mastoid process
Diseases of the ear and mastoid process x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the circulatory system
Diseases of the ear and mastoid process x Endocrine, nutritional and metabolic diseases	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the respiratory system
Diseases of the ear and mastoid process x Mental and behavioural disorders	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the digestive system

Diseases of the ear and mastoid process x Diseases of the nervous system	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the skin and subcutaneous tissue
Diseases of the ear and mastoid process x Diseases of the eye and adnexa	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the musculoskeletal system and connective tissue
Diseases of the circulatory system x Certain infectious and parasitic diseases	Congenital malformations, deformations and chromosomal abnormalities x Diseases of the genitourinary system
Diseases of the circulatory system x Neoplasms	Congenital malformations, deformations and chromosomal abnormalities x Pregnancy, childbirth and the puerperium
Diseases of the circulatory system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Congenital malformations, deformations and chromosomal abnormalities x Certain conditions originating in the perinatal period
Diseases of the circulatory system x Endocrine, nutritional and metabolic diseases	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Certain infectious and parasitic diseases
Diseases of the circulatory system x Mental and behavioural disorders	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Neoplasms
Diseases of the circulatory system x Diseases of the nervous system	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
Diseases of the circulatory system x Diseases of the eye and adnexa	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Endocrine, nutritional and metabolic diseases
Diseases of the circulatory system x Diseases of the ear and mastoid process	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Mental and behavioural disorders
Diseases of the respiratory system x Certain infectious and parasitic diseases	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the nervous system
Diseases of the respiratory system x Neoplasms	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the eye and adnexa
Diseases of the respiratory system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the ear and mastoid process
Diseases of the respiratory system x Endocrine, nutritional and metabolic diseases	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the circulatory system
Diseases of the respiratory system x Mental and behavioural disorders	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the respiratory system
Diseases of the respiratory system x Diseases of the nervous system	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the digestive system

Diseases of the respiratory system x Diseases of the eye and adnexa	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the skin and subcutaneous tissue
Diseases of the respiratory system x Diseases of the ear and mastoid process	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the musculoskeletal system and connective tissue
Diseases of the respiratory system x Diseases of the circulatory system	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the genitourinary system
Diseases of the digestive system x Certain infectious and parasitic diseases	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Pregnancy, childbirth and the puerperium
Diseases of the digestive system x Neoplasms	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Certain conditions originating in the perinatal period
Diseases of the digestive system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Congenital malformations, deformations and chromosomal abnormalities
Diseases of the digestive system x Endocrine, nutritional and metabolic diseases	Injury, poisoning and certain other consequences of external causes x Certain infectious and parasitic diseases
Diseases of the digestive system x Mental and behavioural disorders	Injury, poisoning and certain other consequences of external causes x Neoplasms
Diseases of the digestive system x Diseases of the nervous system	Injury, poisoning and certain other consequences of external causes x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
Diseases of the digestive system x Diseases of the eye and adnexa	Injury, poisoning and certain other consequences of external causes x Endocrine, nutritional and metabolic diseases
Diseases of the digestive system x Diseases of the ear and mastoid process	Injury, poisoning and certain other consequences of external causes x Mental and behavioural disorders
Diseases of the digestive system x Diseases of the circulatory system	Injury, poisoning and certain other consequences of external causes x Diseases of the nervous system
Diseases of the digestive system x Diseases of the respiratory system	Injury, poisoning and certain other consequences of external causes x Diseases of the eye and adnexa
Diseases of the skin and subcutaneous tissue x Certain infectious and parasitic diseases	Injury, poisoning and certain other consequences of external causes x Diseases of the ear and mastoid process
Diseases of the skin and subcutaneous tissue x Neoplasms	Injury, poisoning and certain other consequences of external causes x Diseases of the circulatory system
Diseases of the skin and subcutaneous tissue x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Injury, poisoning and certain other consequences of external causes x Diseases of the respiratory system

Diseases of the skin and subcutaneous tissue x Endocrine, nutritional and metabolic diseases	Injury, poisoning and certain other consequences of external causes x Diseases of the digestive system
Diseases of the skin and subcutaneous tissue x Mental and behavioural disorders	Injury, poisoning and certain other consequences of external causes x Diseases of the skin and subcutaneous tissue
Diseases of the skin and subcutaneous tissue x Diseases of the nervous system	Injury, poisoning and certain other consequences of external causes x Diseases of the musculoskeletal system and connective tissue
Diseases of the skin and subcutaneous tissue x Diseases of the eye and adnexa	Injury, poisoning and certain other consequences of external causes x Diseases of the genitourinary system
Diseases of the skin and subcutaneous tissue x Diseases of the ear and mastoid process	Injury, poisoning and certain other consequences of external causes x Pregnancy, childbirth and the puerperium
Diseases of the skin and subcutaneous tissue x Diseases of the circulatory system	Injury, poisoning and certain other consequences of external causes x Certain conditions originating in the perinatal period
Diseases of the skin and subcutaneous tissue x Diseases of the respiratory system	Injury, poisoning and certain other consequences of external causes x Congenital malformations, deformations and chromosomal abnormalities
Diseases of the skin and subcutaneous tissue x Diseases of the digestive system	Injury, poisoning and certain other consequences of external causes x Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
Diseases of the musculoskeletal system and connective tissue x Certain infectious and parasitic diseases	External causes of morbidity and mortality x Certain infectious and parasitic diseases
Diseases of the musculoskeletal system and connective tissue x Neoplasms	External causes of morbidity and mortality x Neoplasms
Diseases of the musculoskeletal system and connective tissue x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	External causes of morbidity and mortality x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
Diseases of the musculoskeletal system and connective tissue x Endocrine, nutritional and metabolic diseases	External causes of morbidity and mortality x Endocrine, nutritional and metabolic diseases
Diseases of the musculoskeletal system and connective tissue x Mental and behavioural disorders	External causes of morbidity and mortality x Mental and behavioural disorders
Diseases of the musculoskeletal system and connective tissue x Diseases of the nervous system	External causes of morbidity and mortality x Diseases of the nervous system
Diseases of the musculoskeletal system and connective tissue x Diseases of the eye and adnexa	External causes of morbidity and mortality x Diseases of the eye and adnexa
Diseases of the musculoskeletal system and connective tissue x Diseases of the ear and mastoid process	External causes of morbidity and mortality x Diseases of the ear and mastoid process
Diseases of the musculoskeletal system and connective tissue x Diseases of the circulatory system	External causes of morbidity and mortality x Diseases of the circulatory system

Diseases of the musculoskeletal system and connective tissue x Diseases of the respiratory system	External causes of morbidity and mortality x Diseases of the respiratory system
Diseases of the musculoskeletal system and connective tissue x Diseases of the digestive system	External causes of morbidity and mortality x Diseases of the digestive system
Diseases of the musculoskeletal system and connective tissue x Diseases of the skin and subcutaneous tissue	External causes of morbidity and mortality x Diseases of the skin and subcutaneous tissue
Diseases of the genitourinary system x Certain infectious and parasitic diseases	External causes of morbidity and mortality x Diseases of the musculoskeletal system and connective tissue
Diseases of the genitourinary system x Neoplasms	External causes of morbidity and mortality x Diseases of the genitourinary system
Diseases of the genitourinary system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	External causes of morbidity and mortality x Pregnancy, childbirth and the puerperium
Diseases of the genitourinary system x Endocrine, nutritional and metabolic diseases	External causes of morbidity and mortality x Certain conditions originating in the perinatal period
Diseases of the genitourinary system x Mental and behavioural disorders	External causes of morbidity and mortality x Congenital malformations, deformations and chromosomal abnormalities
Diseases of the genitourinary system x Diseases of the nervous system	External causes of morbidity and mortality x Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
Diseases of the genitourinary system x Diseases of the eye and adnexa	External causes of morbidity and mortality x Injury, poisoning and certain other consequences of external causes
Diseases of the genitourinary system x Diseases of the ear and mastoid process	Factors influencing health status and contact with health services x Certain infectious and parasitic diseases
Diseases of the genitourinary system x Diseases of the circulatory system	Factors influencing health status and contact with health services x Neoplasms
Diseases of the genitourinary system x Diseases of the respiratory system	Factors influencing health status and contact with health services x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
Diseases of the genitourinary system x Diseases of the digestive system	Factors influencing health status and contact with health services x Endocrine, nutritional and metabolic diseases
Diseases of the genitourinary system x Diseases of the skin and subcutaneous tissue	Factors influencing health status and contact with health services x Mental and behavioural disorders
Diseases of the genitourinary system x Diseases of the musculoskeletal system and connective tissue	Factors influencing health status and contact with health services x Diseases of the nervous system
Pregnancy, childbirth and the puerperium x Certain infectious and parasitic diseases	Factors influencing health status and contact with health services x Diseases of the eye and adnexa

Pregnancy, childbirth and the puerperium x Neoplasms	Factors influencing health status and contact with health services x Diseases of the ear and mastoid process
Pregnancy, childbirth and the puerperium x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Factors influencing health status and contact with health services x Diseases of the circulatory system
Pregnancy, childbirth and the puerperium x Endocrine, nutritional and metabolic diseases	Factors influencing health status and contact with health services x Diseases of the respiratory system
Pregnancy, childbirth and the puerperium x Mental and behavioural disorders	Factors influencing health status and contact with health services x Diseases of the digestive system
Pregnancy, childbirth and the puerperium x Diseases of the nervous system	Factors influencing health status and contact with health services x Diseases of the skin and subcutaneous tissue
Pregnancy, childbirth and the puerperium x Diseases of the eye and adnexa	Factors influencing health status and contact with health services x Diseases of the musculoskeletal system and connective tissue
Pregnancy, childbirth and the puerperium x Diseases of the ear and mastoid process	Factors influencing health status and contact with health services x Diseases of the genitourinary system
Pregnancy, childbirth and the puerperium x Diseases of the circulatory system	Factors influencing health status and contact with health services x Pregnancy, childbirth and the puerperium
Pregnancy, childbirth and the puerperium x Diseases of the respiratory system	Factors influencing health status and contact with health services x Certain conditions originating in the perinatal period
Pregnancy, childbirth and the puerperium x Diseases of the digestive system	Factors influencing health status and contact with health services x Congenital malformations, deformations and chromosomal abnormalities
Pregnancy, childbirth and the puerperium x Diseases of the skin and subcutaneous tissue	Factors influencing health status and contact with health services x Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
Pregnancy, childbirth and the puerperium x Diseases of the musculoskeletal system and connective tissue	Factors influencing health status and contact with health services x Injury, poisoning and certain other consequences of external causes
Pregnancy, childbirth and the puerperium x Diseases of the genitourinary system	Factors influencing health status and contact with health services x External causes of morbidity and mortality

Attributed need variables

Variables not included in PCA	
Log population variance	%Disability Live Allowance/Personal Independence Payment
% carer (GP survey)	
% permanently sick or disabled (GP survey)	Proportion Single (never married) (Census)
% Full-time education (GP survey)	Proportion Separated (but still legally married) (Census)
% fully retired from work (GP survey)	Proportion Divorced (Census)
% Long-term health condition (GP survey)	Proportion Widowed (Census)
Average number of conditions for those with at least one long term medical condition (GP survey)	Proportion of students in population (aged 16-74) (Census)
% Long-term physical or mental health conditions, disabilities or illnesses - (GP survey)	Crime Score (IMD)
When last general practice appointment was - % In the past 3 months (GP survey)	
Variables included and surviving PCA	
Quality outcomes framework prevalence measures	
QOF Hypertension Prevalence	QOF Osteoperosis Prevalence
QOF Coronary Heart Disease Prevalence	QOF Learning Disabilities Prevalence
QOF Stroke Prevalence	QOF Mental Health Prevalence
Barriers (IMD)	
Homelessness indicator (rate per 1000 households)	Road distance to a GP surgery (km)
Road distance to a post office indicator (km)	Road distance to a general store (km)
Road distance to a primary school (km)	Housing affordability indicator
Education	
Adult skills and English language proficiency indicators – combined (IMD)	Entry to higher education indicator (IMD)
Staying on in education post 16 indicator (IMD)	Proportion with no qualifications (Census)
Health	
Comparative illness and disability ratio indicator (IMD)	Proportion (un standardised) with LLTI (Census)
Potential years of life lost indicator (IMD)	Mood and anxiety disorders indicator (Census)
Income	
Income Score (IMD)	Proportion aged 16-74 in semi-routine occupation (Census)
Proportion aged 16+ in low grade work, long term unemployed or never worked (Census)	Proportion aged 16-74 in routine occupation (Census)
Living environment (IMD)	
Housing in poor condition indicator	Air quality indicator
Houses without central heating indicator	Road traffic accidents indicator
Immunisation	
% immunised DTaP/IPV/Hib by 12 months	% immunised for Pneumococcal disease by 12 months
% immunised DTaP/IPV/Hib by 24 months	% receiving MMR 2nd dose by fifth birthday
% immunised for Meningitis B by 12 months	

Attributed supply variables

Variables not included in PCA	
Gravity weighted travel duration to hospital	Proportion headcount GPs female (including retainers and registrars)
No FTE GPs per practice (excluding retainers and registrars)	Proportion of GPs aged 50 and over in practice (headcount, including retainers a
registrations per FTE (excluding retainers and registrars)	Proportion (headcount) GPs qualified in UK
Variables included and surviving PCA	
Quality outcomes framework scores	
QOF Atrial Fibrillation Weighted Achievement Score	QOF Chronic kidney disease Weighted Achievement Score
QOF Coronary Heart Disease Weighted Achievement Score	QOF Obesity Weighted Achievement Score
QOF Stroke Weighted Achievement Score	QOF Osteoporosis Weighted Achievement Score
Quality outcomes framework exception rates	
QOF Atrial Fibrillation Exception Rate	QOF Dementia Exception Rate
QOF Hypertension Exception Rate	QOF Rheumatoid arthritis Exception Rate
QOF Coronary Heart Disease Exception Rate	QOF Asthma Exception Rate
QOF Contraception Exception Rate	QOF Cancer Exception Rate
Hospital supply (gravity weighted)	
Plain Radiography	critical care beds (occupied)
General & Acute day beds	Median waiting times (weeks) for non-admitted patients
Total Operating theatres	

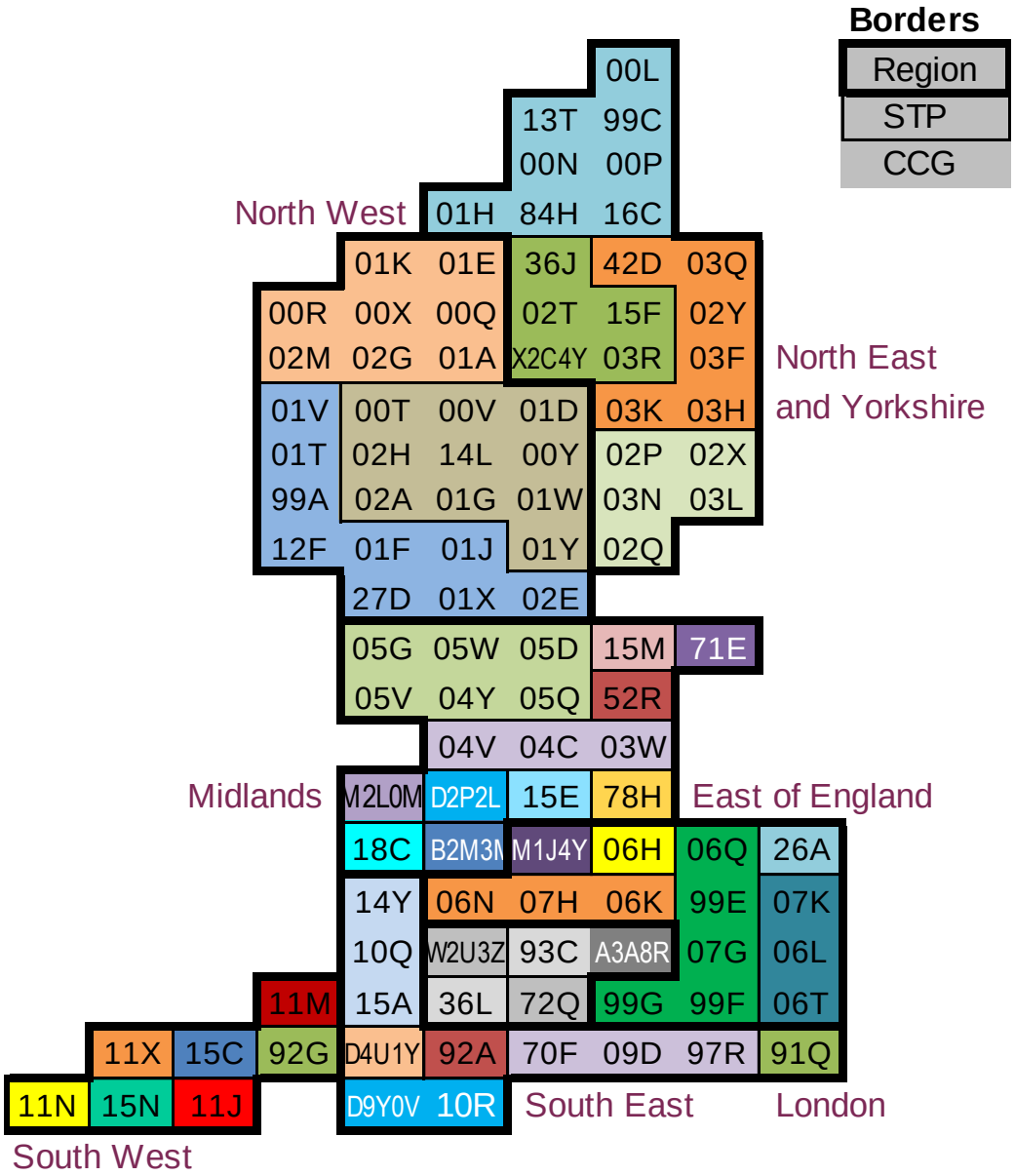
CCG-specific variables

NHS Airedale, Wharfedale and Craven CCG	NHS Merton CCG
NHS Ashford CCG	NHS Mid Essex CCG
NHS Barking and Dagenham CCG	NHS Milton Keynes CCG
NHS Barnet CCG	NHS Morecambe Bay CCG
NHS Barnsley CCG	NHS Nene CCG
NHS Basildon and Brentwood CCG	NHS Newark and Sherwood CCG
NHS Bassetlaw CCG	NHS Newcastle Gateshead CCG
NHS Bath and North East Somerset CCG	NHS Newham CCG
NHS Bedfordshire CCG	NHS North Cumbria CCG
NHS Berkshire West CCG	NHS North Durham CCG
NHS Bexley CCG	NHS North East Essex CCG
NHS Birmingham and Solihull CCG	NHS North East Hampshire and Farnham CCG
NHS Blackburn with Darwen CCG	NHS North East Lincolnshire CCG
NHS Blackpool CCG	NHS North Hampshire CCG
NHS Bolton CCG	NHS North Kirklees CCG
NHS Bradford City CCG	NHS North Lincolnshire CCG
NHS Bradford Districts CCG	NHS North Norfolk CCG
NHS Brent CCG	NHS North Staffordshire CCG
NHS Brighton and Hove CCG	NHS North Tyneside CCG
NHS Bristol, North Somerset and South Gloucestershire CCG	NHS North West Surrey CCG

NHS Bromley CCG	NHS Northern, Eastern and Western Devon CCG
NHS Buckinghamshire CCG	NHS Northumberland CCG
NHS Bury CCG	NHS Norwich CCG
NHS Calderdale CCG	NHS Nottingham City CCG
NHS Cambridgeshire and Peterborough CCG	NHS Nottingham North and East CCG
NHS Camden CCG	NHS Nottingham West CCG
NHS Cannock Chase CCG	NHS Oldham CCG
NHS Canterbury and Coastal CCG	NHS Oxfordshire CCG
NHS Castle Point and Rochford CCG	NHS Portsmouth CCG
NHS Central London (Westminster) CCG	NHS Redbridge CCG
NHS Chorley and South Ribble CCG	NHS Redditch and Bromsgrove CCG
NHS City and Hackney CCG	NHS Richmond CCG
NHS Coastal West Sussex CCG	NHS Rotherham CCG
NHS Corby CCG	NHS Rushcliffe CCG
NHS Coventry and Rugby CCG	NHS Salford CCG
NHS Crawley CCG	NHS Sandwell and West Birmingham CCG
NHS Croydon CCG	NHS Scarborough and Ryedale CCG
NHS Darlington CCG	NHS Sheffield CCG
NHS Dartford, Gravesham and Swanley CCG	NHS Shropshire CCG
NHS Doncaster CCG	NHS Somerset CCG
NHS Dorset CCG	NHS South Cheshire CCG
NHS Dudley CCG	NHS South Devon and Torbay CCG
NHS Durham Dales, Easington and Sedgefield CCG	NHS South East Staffordshire and Seisdon Peninsula CCG
NHS Ealing CCG	NHS South Eastern Hampshire CCG
NHS East and North Hertfordshire CCG	NHS South Kent Coast CCG
NHS East Berkshire CCG	NHS South Lincolnshire CCG
NHS East Lancashire CCG	NHS South Norfolk CCG
NHS East Leicestershire and Rutland CCG	NHS South Sefton CCG
NHS East Riding of Yorkshire CCG	NHS South Tees CCG
NHS East Staffordshire CCG	NHS South Tyneside CCG
NHS East Surrey CCG	NHS South Warwickshire CCG
NHS Eastbourne, Hailsham and Seaford CCG	NHS South West Lincolnshire CCG
NHS Eastern Cheshire CCG	NHS South Worcestershire CCG
NHS Enfield CCG	NHS Southampton CCG
NHS Fareham and Gosport CCG	NHS Southend CCG
NHS Fylde and Wyre CCG	NHS Southport and Formby CCG
NHS Gloucestershire CCG	NHS Southwark CCG
NHS Great Yarmouth and Waveney CCG	NHS St Helens CCG
NHS Greater Huddersfield CCG	NHS Stafford and Surrounds CCG
NHS Greater Preston CCG	NHS Stockport CCG
NHS Greenwich CCG	NHS Stoke on Trent CCG
NHS Guildford and Waverley CCG	NHS Sunderland CCG
NHS Halton CCG	NHS Surrey Downs CCG
NHS Hambleton, Richmondshire and Whitby CCG	NHS Surrey Heath CCG
NHS Hammersmith and Fulham CCG	NHS Sutton CCG
NHS Haringey CCG	NHS Swale CCG
NHS Harrogate and Rural District CCG	NHS Swindon CCG
NHS Harrow CCG	NHS Tameside and Glossop CCG

NHS Hartlepool and Stockton-on-Tees CCG	NHS Telford and Wrekin CCG
NHS Hastings and Rother CCG	NHS Thanet CCG
NHS Havering CCG	NHS Thurrock CCG
NHS Herefordshire CCG	NHS Tower Hamlets CCG
NHS Herts Valleys CCG	NHS Trafford CCG
NHS Heywood, Middleton and Rochdale CCG	NHS Vale of York CCG
NHS High Weald Lewes Havens CCG	NHS Vale Royal CCG
NHS Hillingdon CCG	NHS Wakefield CCG
NHS Horsham and Mid Sussex CCG	NHS Walsall CCG
NHS Hounslow CCG	NHS Waltham Forest CCG
NHS Hull CCG	NHS Wandsworth CCG
NHS Ipswich and East Suffolk CCG	NHS Warrington CCG
NHS Isle of Wight CCG	NHS Warwickshire North CCG
NHS Islington CCG	NHS West Cheshire CCG
NHS Kernow CCG	NHS West Essex CCG
NHS Kingston CCG	NHS West Hampshire CCG
NHS Knowsley CCG	NHS West Kent CCG
NHS Lambeth CCG	NHS West Lancashire CCG
NHS Leeds CCG	NHS West Leicestershire CCG
NHS Leicester City CCG	NHS West London CCG
NHS Lewisham CCG	NHS West Norfolk CCG
NHS Lincolnshire East CCG	NHS West Suffolk CCG
NHS Lincolnshire West CCG	NHS Wigan Borough CCG
NHS Liverpool CCG	NHS Wiltshire CCG
NHS Luton CCG	NHS Wirral CCG
NHS Manchester CCG	NHS Wolverhampton CCG
NHS Mansfield and Ashfield CCG	NHS Wyre Forest CCG
NHS Medway CCG	

Annex D: Cartogram reference map



Annex E: Coefficients for the specialised services model

Variable	Coefficient	Significance
Constant	-17.1	0.647
Privately funded care	-201.1	0

Age and sex

Variable	Coefficient	Significance
Male	26.6	0
Age <1	-116.1	0
Age 1-4	117.8	0
Age 5-9	1.1	0.461
Age 10-14	5.5	0
Age 15-19	-24.1	0
Age 20-24	15.4	0
Age 25-29	1.2	0.22
Age 30-34	1.2	0.216
Age 35-39	-0.5	0.632
Age 40-44	1.3	0.208
Age 45-49	0.2	0.82
Age 50-54	-2.0	0.045
Age 55-59	2.0	0.049
Age 60-64	0.9	0.397
Age 65-69	-3.6	0.001
Age 70-74	-0.2	0.893
Age 75-79	-10.4	0
Age 80-84	-6.3	0
Age 85+	11.9	0
Male: Age <1	-29.6	0
Male: Age 1-4	32.8	0
Male: Age 5-9	-2.6	0.163
Male: Age 10-14	-1.7	0.262
Male: Age 15-19	2.8	0.069
Male: Age 20-24	-2.0	0.164
Male: Age 25-29	-0.4	0.76
Male: Age 30-34	-0.5	0.73
Male: Age 35-39	1.2	0.388
Male: Age 40-44	0.4	0.793
Male: Age 45-49	0.3	0.835
Male: Age 50-54	4.9	0
Male: Age 55-59	-0.2	0.876
Male: Age 60-64	0.9	0.57

Male: Age 65-69	0.0	1
Male: Age 70-74	0.2	0.906
Male: Age 75-79	-7.5	0
Male: Age 80-84	-13.4	0
Male: Age 85+	0.1	0.971

Household type

Variable	Coefficient	Significance
Multi Adult	Reference	
Care home	-122.5	0
Multi-adult-child	-6.9	0
Multi-child	-15.6	0.042
Other communal	-21.6	0
Single parent	-1.8	0.158
Single person	8.3	0
Two adult family	-3.3	0
Two adults diff gender	8.6	0
Two adults same gender	3.8	0.015
Unknown	-2.3	0.061

Ethnicity

Variable	Coefficient	Significance
White British	n/a	n/a
White Irish	-3.8	0.379
Other White	-5.2	0
White and Black Caribbean	-17.1	0
White and Black African	-16.7	0.011
White and Asian	-29.2	0
Other Mixed	-10.2	0.001
Indian	-0.6	0.789
Pakistani	19.5	0
Bangladeshi	9.5	0.009
Chinese	-24.9	0
Other Asian	2.5	0.288
African	31.5	0
Caribbean	49.7	0
Other Black	32.0	0
Any other ethnic group	11.4	0

Diagnoses

Variable	Coefficient	Significance	Mean Predicted Costs
A00-A09 Intestinal infectious diseases	-37.3	0	£890
A15-A19 Tuberculosis	332.4	0	£1,450
A20-A49 Certain bacterial diseases	75.3	0	£1,779
A50-A64 Infections with predominantly sexual mode of transmission	-577.9	0.759	£10
A65-A79 Other infectious and parasitic disorders	-33.8	0.501	£554
A80-A89 Viral infections of the central nervous system	-398.9	0	£387
A90-A99 Arthropod-borne viral fevers & viral haemorrhagic fevers	-190.2	0.04	£289
B00-B09 Viral infections characterized by skin & mucous membrane lesions	129.7	0	£1,175
B15-B19 Viral hepatitis	700.9	0	£1,786
B20-B24 Human immunodeficiency virus [HIV] disease	-	-	
B25-B34 Other viral diseases	-52.4	0	£586
B35-B49 Mycoses	174.6	0	£1,584
B50-B64 Protozoal diseases	-118.2	0	£1,231
B65-B83 Helminthiases	-82.3	0.003	£407
B85-B99 Other infectious and parasitic diseases	157.8	0	£1,237
C00-C14 Malignant neoplasm of liporal cavity and pharynx	752.5	0	£2,098
C15-C26 Malignant neoplasm of digestive organs	828.5	0	£2,631
C30-C39 Malignant neoplasms of respiratory & intrathoracic organs	1369.1	0	£3,565
C40-C41 Malignant neoplasm of bone and articular cartilage	1579.5	0	£6,852
C43-C44 Malignant neoplasms of skin	77.3	0	£745
C45-C49 Malignant neoplasms of mesothelial and soft tissue	1417.5	0	£4,152
C50 Malignant neoplasm of breast	519.2	0	£2,182
C51-C58 Malignant neoplasms of female genital organs	648.0	0	£2,215
C60-C63 Malignant neoplasms of male genital organs	368.1	0	£1,305
C64-C68 Malignant neoplasms of urinary tract	495.8	0	£1,660
C69-C72 Malignant neoplasms of eye, brain & other parts of CNS	2482.0	0	£4,103
C73-C80, C97 Malignant neoplasm. of thyroid and other endo. Glands etc.	1667.3	0	£4,189
C81-C96 Malignant neoplasms of lymphoid, haematopoietic & rel. tissue	2084.9	0	£4,983
D00-D48 In situ & benign neoplasms and others of uncertainty	20.3	0	£626
D50-D64 Anaemias	28.4	0	£1,134

D65-D89 Diseases of the blood and blood-forming organs	133.3	0	£1,757
E00-E07 Disorders of thyroid gland	-77.1	0	£567
E10-E14 Diabetes Mellitus	-8.9	0	£750
E15-E90 Endocrine nutritional and metabolic diseases	29.4	0	£791
F00-F03 Dementia	-234.9	0	£167
F04-F09 Other organic including symptomatic mental disorders	-197.3	0	£478
F10-F19 Mental and behavioural disorders due to psychoactive subst.	-65.5	0	£432
F20-F29 Schizophrenia, schizotypal and delusional disorders	-101.2	0	£343
F30-F39 Mood [affective] disorders	-97.4	0	£437
F40-F69 Neurotic, behavioural & personality disorders	-68.7	0	£449
F70-F79 Mental retardation	-37.7	0.003	£1,118
F80-F99 Other mental and behavioural disorders	125.2	0	£1,041
G00-G09 Inflammatory diseases of the central nervous system	694.7	0	£1,900
G10-G14, G30-G32 Other degenerative diseases (incl. Alzheimer).	108.3	0	£368
G20-G26 Extrapyramidal & movement disorders (incl. Parkinsonism).	127.3	0	£708
G35-G37 Demyelinating diseases (incl Multiple Sclerosis) of the CNS.	1081.7	0	£2,243
G40-G47 Epilepsy, migraine & other episodic disorders	70.7	0	£731
G50-G73 G90-G99 Other diseases & disorders of the nervous syst.	266.6	0	£1,091
G80-G83 Cerebral palsy & other paralytic syndromes	309.3	0	£1,281
H00-H06, H15-H22, H30-H36, H43-H59 Other disorders of the eye etc.	0.2	0.953	£751
H10-H13 Disorders of conjunctiva (including conjunctivitis)	-61.9	0	£805
H25-H28 Disorders of lens (including cataracts)	-117.3	0	£435
H40-H42 Glaucoma	-110.6	0	£512
H60-H95 Diseases of the ear and mastoid process	7.4	0.106	£633
I00-I09 Rheumatic heart disease	151.5	0	£1,362
I10-I15 Hypertensive diseases	-55.5	0	£681
I20-I25 Ischaemic heart diseases	32.8	0	£782
I26-I28 Pulmonary heart disease & diseases of pulmonary circulation	43.8	0	£1,617
I30-I52 Other forms of heart disease	96.5	0	£889
I60-I69 Cerebrovascular diseases	-64.8	0	£719
I70-I79 Diseases of arteries, arterioles & capillaries	169.8	0	£1,243
I80-I89 Diseases of veins & lymphatic system nec.	-50.2	0	£841

I95-I99 Other & unspecified disorders of the circulatory system	-77.1	0	£1,067
J00-J06 Acute upper respiratory infections	-32.9	0	£601
J09-J18 Influenza & pneumonia	-59.1	0	£1,089
J20-J22 Other acute lower respiratory infections	21.3	0	£1,036
J30-J39 Other diseases of upper respiratory tract	-73.6	0	£529
J40-J47 Chronic lower respiratory diseases	-119.8	0	£517
J60-J70 Lung diseases due to external agents	-206.5	0	£972
J80-J99 Other diseases of the respiratory system	92.0	0	£1,461
K00-K14 Diseases of oral cavity, salivary glands & jaws	258.2	0	£1,919
K20-K31 Diseases of oesophagus, stomach & duodenum	-76.9	0	£575
K35-K38 Diseases of appendix	-134.7	0	£178
K40-K46 Hernia	-127.3	0	£453
K50-K52 Noninfective enteritis & colitis	-37.9	0	£610
K55-K64 Other diseases of intestines	-82.1	0	£556
K65-K67 Diseases of peritoneum	-126.2	0	£937
K70-K77 Diseases of liver	59.2	0	£1,080
K80-K87 Disorders of gall bladder, biliary tract & pancreas	-11.4	0.001	£762
K90-K93 Other diseases of the digestive system	-69.1	0	£712
L00-L14 L55-L99 Other infections and disorders of the skin	-65.7	0	£633
L20-L30 Dermatitis and eczema	48.8	0	£794
L40-L45 Papulosquamous disorders (including Psoriasis)	-5.3	0.432	£633
L50-L54 Urticaria and erythems	56.5	0	£1,144
M00-M25 Arthropathies	-85.9	0	£504
M30-M36 Systemic connective tissue disorders	108.1	0	£1,027
M40-M54 Dorsopathies	-53.8	0	£596
M60-M79 Soft tissue disorders	-79.5	0	£494
M80-M94 Osteopathies and chondropathies	-6.3	0.064	£799
M95-M99 Other disorders of the musculoskeletal system & connective tissue	-113.0	0	£524
N00-N08, N10-N16 Diseases of the kidney	433.7	0	£2,156
N17-N19 Renal failure	170.5	0	£1,476
N20-N23 Urolithiasis	-281.0	0	£483
N25-N29 Other disorders of kidney & ureter	260.2	0	£1,898
N30-N39 Other diseases of the urinary system	-212.1	0	£655
N40-N51 Diseases of male genital organs	-138.9	0	£576
N60-N64 Disorders of breast	-111.1	0	£618
N70-N77 Inflammatory diseases of female pelvic organs	-114.4	0	£322
N80-N98 Noninflammatory disorders of female genital tract	-81.7	0	£275
N99 Other disorders of the genitourinary system	-576.2	0	£933
O00-O08 Pregnancy with abortive outcome	-55.4	0	£65
O10-O75, O85-O92, O94-O99 Complications of labour and delivery	-72.8	0	£44

O80-O84 Delivery	-66.9	0	£28
P00-P04 Complications of foetus/neonate affected by maternal	-47.2	0	£285
P05-P96 Other conditions originating in the perinatal period	-132.6	0	£270
Q00-Q89 Congenital malformations	142.4	0	£1,100
Q90-Q99 Chromosomal abnormalities	453.8	0	£2,007
R00-R09 Symptoms & signs inv. the circulatory/respiratory system	-29.0	0	£726
R10-R19 Symptoms & signs inv. the digestive system & abdomen	-71.3	0	£574
R20-R23 Symptoms & signs inv. the skin & subcutaneous tissue	33.5	0	£1,053
R25-R29 Symptoms & signs inv. the nervous & musculoskeletal sys.	-158.8	0	£616
R30-R39 Symptoms & signs involving the urinary system	-165.0	0	£656
R40-R46 Symptoms & signs inv. Cognition, perception etc.	-112.5	0	£616
R47-R49 Symptoms & signs inv. speech & voice	-21.2	0.004	£856
R50-R68 General symptoms & signs	-0.4	0.833	£925
R69 Unknown & unspecified causes of morbidity	-371.9	0	£694
R70-R89 Abnormal findings of bodily fluids or samples without diag.	39.2	0	£1,189
R90-R94 Abnormal findings on diagnostic imaging/function studies	49.2	0	£1,322
R95-R99 Ill-defined & unknown causes of mortality	65.8	0.864	£1,050
S00-S09 Injuries to the head	-15.4	0	£429
S10-S19 Injuries to the neck	436.2	0	£911
S20-S29 Injuries to the thorax	63.4	0	£666
S30-S39 Injuries to abdomen, lower back, lumbar spine & pelvis	-19.4	0.003	£536
S40-S49 Injuries to the shoulder & upper arm	-55.3	0	£370
S50-S59 Injuries to the elbow & forearm	-53.7	0	£262
S60-S69 Injuries to the wrist & hand	-26.9	0	£218
S70-S79 Injuries to the hip & thigh	-121.7	0	£401
S80-S89 Injuries to the knee & lower leg	-56.0	0	£369
S90-S99 Injuries to the ankle & foot	-54.4	0	£430
T00-T07 Injuries involving multiple body regions	-80.7	0	£421
T08-T14 Injuries to unspecified part of trunk limb or body	-37.1	0.04	£683
T15-T19 Effects of foreign body entering through natural orifice	-7.4	0.494	£492
T20-T32 Burns and corrosions	-104.6	0	£427
T33-T35 Frostbite	1911.5	0	£2,653
T36-T50 Poisonings by drugs medicaments & biological substances	-171.4	0	£286
T51-T65 Toxic effects. of substances. chiefly non-medicinal as to source	-38.0	0	£232

T66-T78 Other and unspecified effects of external causes	-158.0	0	£530
T79 Certain early complications of trauma	-88.1	0	£544
T80-T88 Complications of surgical & medical care nec.	267.7	0	£1,807
T90-T98 Sequelae of injuries of poisoning & other consequences	-50.2	0	£621
VVV	-136.3	0	£300
WWW	-176.7	0	£343
XXX	-16.9	0	£651
YYY	-139.6	0	£1,388
Z00-Z13 Examination and investigation	-70.0	0	£521
Z20-Z29 Potential health hazards related to communicable diseases	55.7	0	£860
Z30-Z39 Health services in circumstances related to reproduction	-116.7	0	£96
Z40-Z54 Persons encountering health services for specific care	57.8	0	£1,291
Z55-Z65 Potential health hazards related. to socioeconomic & psychosoc.l	-91.6	0	£561
Z70-Z76 Persons encountering health services in other circumstances	-64.8	0	£630
Z80-Z99 Persons with potential health hazards related to family	-23.1	0	£677
U Unclassified	-35.6	0	£1,595

Morbidity count

Variable	Coefficient	Significance
A00-A09 Intestinal infectious diseases	698.0	0
A15-A19 Tuberculosis	-344.9	0
A20-A49 Certain bacterial diseases	108.5	0
B15-B19 Viral hepatitis	1777.0	0
B25-B34 Other viral diseases	-53.3	0.007
B35-B49 Mycoses	3674.4	0
B85-B99 Other infectious and parasitic diseases	1683.5	0
C00-C14 Malignant neoplasm of liporal cavity and pharynx	-1671.8	0
C15-C26 Malignant neoplasm of digestive organs	-169.7	0
C30-C39 Malignant neoplasms of respiratory & intrathoracic organs	608.0	0
C40-C41 Malignant neoplasm of bone and articular cartilage	6487.5	0
C43-C44 Malignant neoplasms of skin	1060.6	0
C45-C49 Malignant neoplasms of mesothelial and soft tissue	1395.6	0
C50 Malignant neoplasm of breast	367.9	0
C51-C58 Malignant neoplasms of female genital organs	-214.1	0

C60-C63 Malignant neoplasms of male genital organs	-647.7	0
C64-C68 Malignant neoplasms of urinary tract	116.2	0
C69-C72 Malignant neoplasms of eye, brain & other parts of CNS	516.0	0
C73-C80, C97 Malignant neoplasm. of thyroid and other endo. Glands etc.	1616.1	0
C81-C96 Malignant neoplasms of lymphoid, haematopoietic & rel. tissue	2556.6	0
D00-D48 In situ & benign neoplasms and others of uncertainty	709.8	0
D50-D64 Anaemias	496.8	0
D65-D89 Diseases of the blood and blood-forming organs	1028.9	0
E00-E07 Disorders of thyroid gland	-92.5	0
E10-E14 Diabetes Mellitus	-49.2	0
E15-E90 Endocrine nutritional and metabolic diseases	442.8	0
F00-F03 Dementia	-263.9	0
F04-F09 Other organic including symptomatic mental disorders	-381.2	0
F10-F19 Mental and behavioural disorders due to psychoactive subst.	-89.5	0
F20-F29 Schizophrenia, schizotypal and delusional disorders	-165.6	0
F30-F39 Mood [affective] disorders	-40.4	0
F40-F69 Neurotic, behavioural & personality disorders	-67.5	0
F80-F99 Other mental and behavioural disorders	732.2	0
G00-G09 Inflammatory diseases of the central nervous system	287.6	0
G35-G37 Demyelinating diseases (incl Multiple Sclerosis) of the CNS.	1794.5	0
G40-G47 Epilepsy, migraine & other episodic disorders	170.6	0
G50-G73 G90-G99 Other diseases & disorders of the nervous syst.	1209.6	0
G80-G83 Cerebral palsy & other paralytic syndromes	323.8	0
H00-H06, H15-H22, H30-H36, H43-H59 Other disorders of the eye etc.	328.8	0
H10-H13 Disorders of conjunctiva (including conjunctivitis)	-92.5	0.17
H25-H28 Disorders of lens (including cataracts)	-249.4	0
H60-H95 Diseases of the ear and mastoid process	392.0	0
I10-I15 Hypertensive diseases	-206.2	0
I20-I25 Ischaemic heart diseases	-328.6	0
I26-I28 Pulmonary heart disease & diseases of pulmonary circulation	2530.7	0
I30-I52 Other forms of heart disease	-279.8	0

I70-I79 Diseases of arteries, arterioles & capillaries	-105.7	0
I95-I99 Other & unspecified disorders of the circulatory system	-341.0	0
J09-J18 Influenza & pneumonia	-402.7	0
J20-J22 Other acute lower respiratory infections	1338.8	0
J30-J39 Other diseases of upper respiratory tract	835.5	0
J40-J47 Chronic lower respiratory diseases	-159.6	0
J60-J70 Lung diseases due to external agents	-529.4	0
J80-J99 Other diseases of the respiratory system	102.4	0
K00-K14 Diseases of oral cavity, salivary glands & jaws	2416.4	0
K20-K31 Diseases of oesophagus, stomach & duodenum	-22.9	0.001
K40-K46 Hernia	-262.8	0
K50-K52 Noninfective enteritis & colitis	75.9	0
K55-K64 Other diseases of intestines	-110.6	0
K65-K67 Diseases of peritoneum	2046.6	0
K70-K77 Diseases of liver	249.6	0
K80-K87 Disorders of gall bladder, biliary tract & pancreas	337.2	0
L00-L14 L55-L99 Other infections and disorders of the skin	-488.4	0
L20-L30 Dermatitis and eczema	824.5	0
L50-L54 Urticaria and erythems	510.0	0
M00-M25 Arthropathies	-142.2	0
M30-M36 Systemic connective tissue disorders	355.0	0
M60-M79 Soft tissue disorders	-17.6	0.101
M80-M94 Osteopathies and chondropathies	319.7	0
N00-N08, N10-N16 Diseases of the kidney	2507.4	0
N17-N19 Renal failure	2251.4	0
N20-N23 Urolithiasis	-443.2	0
N25-N29 Other disorders of kidney & ureter	1990.5	0
N30-N39 Other diseases of the urinary system	-774.0	0
N40-N51 Diseases of male genital organs	-218.9	0
N60-N64 Disorders of breast	-12.1	0.829
N80-N98 Noninflammatory disorders of female genital tract	-133.1	0
N99 Other disorders of the genitourinary system	-2905.6	0
O10-O75, O85-O92, O94-O99 Complications of labour and delivery	-146.1	0
P05-P96 Other conditions originating in the perinatal period	-272.4	0
Q00-Q89 Congenital malformations	1534.7	0
R20-R23 Symptoms & signs inv. the skin & subcutaneous tissue	867.5	0
R25-R29 Symptoms & signs inv. the nervous & musculoskeletal sys.	-428.7	0
R30-R39 Symptoms & signs involving the urinary system	-594.1	0
R50-R68 General symptoms & signs	687.4	0

R70-R89 Abnormal findings of bodily fluids or samples without diag.	959.9	0
R90-R94 Abnormal findings on diagnostic imaging/function studies	491.8	0
S30-S39 Injuries to abdomen, lower back, lumbar spine & pelvis	-178.6	0
S40-S49 Injuries to the shoulder & upper arm	-93.1	0.05
S80-S89 Injuries to the knee & lower leg	348.7	0
T08-T14 Injuries to unspecified part of trunk limb or body	1392.4	0
T15-T19 Effects of foreign body entering through natural orifice	155.0	0.062
T36-T50 Poisonings by drugs medicaments & biological substances	-321.7	0
T80-T88 Complications of surgical & medical care nec.	2016.5	0
WWW	57.4	0
XXX	218.9	0
YYY	673.3	0
Z00-Z13 Examination and investigation	163.2	0
Z20-Z29 Potential health hazards related to communicable diseases	1245.4	0
Z40-Z54 Persons encountering health services for specific care	2867.6	0
Z55-Z65 Potential health hazards related. to socioeconomic & psychosoc.l	596.0	0
Z70-Z76 Persons encountering health services in other circumstances	-146.9	0
Z80-Z99 Persons with potential health hazards related to family	251.9	0
U Unclassified	21.2	0.488

Co-morbidities

Variable	Coefficient	Significance
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism x Certain infectious and parasitic diseases	64.2	0
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism x Neoplasms	-139.4	0
Endocrine, nutritional and metabolic diseases x Certain infectious and parasitic diseases	199.5	0
Endocrine, nutritional and metabolic diseases x Neoplasms	-40.9	0
Mental and behavioural disorders x Certain infectious and parasitic diseases	-128.5	0
Mental and behavioural disorders x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	-149.3	0
Mental and behavioural disorders x Endocrine, nutritional and metabolic diseases	-58.4	0

Diseases of the nervous system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	-41.7	0
Diseases of the nervous system x Endocrine, nutritional and metabolic diseases	-75.5	0
Diseases of the nervous system x Mental and behavioural disorders	-9.7	0.013
Diseases of the eye and adnexa x Certain infectious and parasitic diseases	83.0	0
Diseases of the eye and adnexa x Diseases of the nervous system	126.9	0
Diseases of the ear and mastoid process x Neoplasms	-67.5	0
Diseases of the ear and mastoid process x Diseases of the eye and adnexa	-24.0	0.003
Diseases of the circulatory system x Certain infectious and parasitic diseases	-180.9	0
Diseases of the circulatory system x Neoplasms	-120.0	0
Diseases of the circulatory system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	-107.8	0
Diseases of the circulatory system x Endocrine, nutritional and metabolic diseases	-50.0	0
Diseases of the circulatory system x Mental and behavioural disorders	72.8	0
Diseases of the circulatory system x Diseases of the nervous system	-75.8	0
Diseases of the circulatory system x Diseases of the eye and adnexa	-19.1	0
Diseases of the circulatory system x Diseases of the ear and mastoid process	-79.4	0
Diseases of the respiratory system x Certain infectious and parasitic diseases	39.1	0
Diseases of the respiratory system x Neoplasms	21.6	0
Diseases of the respiratory system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	76.0	0
Diseases of the respiratory system x Endocrine, nutritional and metabolic diseases	59.4	0
Diseases of the digestive system x Certain infectious and parasitic diseases	81.8	0
Diseases of the digestive system x Neoplasms	23.8	0
Diseases of the digestive system x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	-145.4	0
Diseases of the digestive system x Endocrine, nutritional and metabolic diseases	31.3	0
Diseases of the digestive system x Diseases of the nervous system	-37.6	0
Diseases of the digestive system x Diseases of the circulatory system	-51.3	0
Diseases of the digestive system x Diseases of the respiratory system	60.8	0

Diseases of the skin and subcutaneous tissue x Certain infectious and parasitic diseases	-116.1	0
Diseases of the skin and subcutaneous tissue x Endocrine, nutritional and metabolic diseases	-54.6	0
Diseases of the skin and subcutaneous tissue x Mental and behavioural disorders	27.9	0
Diseases of the skin and subcutaneous tissue x Diseases of the nervous system	5.1	0.393
Diseases of the skin and subcutaneous tissue x Diseases of the ear and mastoid process	26.2	0.009
Diseases of the skin and subcutaneous tissue x Diseases of the digestive system	43.2	0
Diseases of the musculoskeletal system and connective tissue x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	-60.6	0
Diseases of the musculoskeletal system and connective tissue x Endocrine, nutritional and metabolic diseases	-41.7	0
Diseases of the musculoskeletal system and connective tissue x Mental and behavioural disorders	51.0	0
Diseases of the musculoskeletal system and connective tissue x Diseases of the nervous system	-124.8	0
Diseases of the musculoskeletal system and connective tissue x Diseases of the ear and mastoid process	61.0	0
Diseases of the musculoskeletal system and connective tissue x Diseases of the circulatory system	-66.1	0
Diseases of the musculoskeletal system and connective tissue x Diseases of the respiratory system	37.4	0
Diseases of the musculoskeletal system and connective tissue x Diseases of the digestive system	36.6	0
Diseases of the genitourinary system x Certain infectious and parasitic diseases	-195.4	0
Diseases of the genitourinary system x Neoplasms	-324.4	0
Diseases of the genitourinary system x Diseases of the nervous system	-49.9	0
Diseases of the genitourinary system x Diseases of the ear and mastoid process	-107.8	0
Diseases of the genitourinary system x Diseases of the circulatory system	158.3	0
Diseases of the genitourinary system x Diseases of the respiratory system	-117.7	0
Diseases of the genitourinary system x Diseases of the digestive system	-79.0	0
Diseases of the genitourinary system x Diseases of the skin and subcutaneous tissue	-97.5	0
Diseases of the genitourinary system x Diseases of the musculoskeletal system and connective tissue	-78.3	0
Pregnancy, childbirth and the puerperium x Certain infectious and parasitic diseases	-153.2	0
Pregnancy, childbirth and the puerperium x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	-232.6	0

Pregnancy, childbirth and the puerperium x Endocrine, nutritional and metabolic diseases	-112.8	0
Certain conditions originating in the perinatal period x Certain infectious and parasitic diseases	-169.2	0
Certain conditions originating in the perinatal period x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	1385.3	0
Certain conditions originating in the perinatal period x Endocrine, nutritional and metabolic diseases	520.9	0
Certain conditions originating in the perinatal period x Mental and behavioural disorders	1190.3	0
Certain conditions originating in the perinatal period x Diseases of the nervous system	838.9	0
Certain conditions originating in the perinatal period x Diseases of the ear and mastoid process	837.3	0
Certain conditions originating in the perinatal period x Diseases of the circulatory system	1358.7	0
Certain conditions originating in the perinatal period x Diseases of the respiratory system	-150.6	0
Certain conditions originating in the perinatal period x Diseases of the digestive system	193.9	0
Certain conditions originating in the perinatal period x Diseases of the musculoskeletal system and connective tissue	483.6	0
Certain conditions originating in the perinatal period x Diseases of the genitourinary system	303.3	0
Certain conditions originating in the perinatal period x Pregnancy, childbirth and the puerperium	-336.3	0.032
Congenital malformations, deformations and chromosomal abnormalities x Neoplasms	-190.4	0
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	452.9	0
Congenital malformations, deformations and chromosomal abnormalities x Mental and behavioural disorders	-214.9	0
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the nervous system	172.9	0
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the eye and adnexa	-90.1	0
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the ear and mastoid process	180.5	0
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the circulatory system	509.2	0
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the digestive system	29.6	0
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the skin and subcutaneous tissue	-24.5	0.027
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the musculoskeletal system and connective tissue	-57.6	0
Congenital malformations, deformations and chromosomal abnormalities x Diseases of the genitourinary system	223.4	0

Congenital malformations, deformations and chromosomal abnormalities x Pregnancy, childbirth and the puerperium	-392.0	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Neoplasms	150.0	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Mental and behavioural disorders	13.3	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the nervous system	54.9	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the circulatory system	-71.5	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the digestive system	12.9	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the musculoskeletal system and connective tissue	62.8	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Diseases of the genitourinary system	-75.4	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified x Congenital malformations, deformations and chromosomal abnormalities	-19.9	0.004
Injury, poisoning and certain other consequences of external causes x Certain infectious and parasitic diseases	135.4	0
Injury, poisoning and certain other consequences of external causes x Neoplasms	-365.8	0
Injury, poisoning and certain other consequences of external causes x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	134.8	0
Injury, poisoning and certain other consequences of external causes x Endocrine, nutritional and metabolic diseases	60.3	0
Injury, poisoning and certain other consequences of external causes x Diseases of the digestive system	-22.8	0
Injury, poisoning and certain other consequences of external causes x Diseases of the skin and subcutaneous tissue	11.9	0.035
Injury, poisoning and certain other consequences of external causes x Diseases of the genitourinary system	220.4	0
Injury, poisoning and certain other consequences of external causes x Pregnancy, childbirth and the puerperium	-110.1	0
Injury, poisoning and certain other consequences of external causes x Certain conditions originating in the perinatal period	358.7	0
Injury, poisoning and certain other consequences of external causes x Congenital malformations, deformations and chromosomal abnormalities	494.6	0
Injury, poisoning and certain other consequences of external causes x Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	-6.7	0.072
External causes of morbidity and mortality x Neoplasms	-48.3	0

External causes of morbidity and mortality x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	137.9	0
External causes of morbidity and mortality x Mental and behavioural disorders	-87.2	0
External causes of morbidity and mortality x Diseases of the nervous system	144.7	0
External causes of morbidity and mortality x Diseases of the ear and mastoid process	5.1	0.647
External causes of morbidity and mortality x Diseases of the circulatory system	109.1	0
External causes of morbidity and mortality x Diseases of the digestive system	-56.9	0
External causes of morbidity and mortality x Diseases of the skin and subcutaneous tissue	51.5	0
External causes of morbidity and mortality x Diseases of the musculoskeletal system and connective tissue	-58.3	0
External causes of morbidity and mortality x Diseases of the genitourinary system	166.5	0
External causes of morbidity and mortality x Certain conditions originating in the perinatal period	592.3	0
External causes of morbidity and mortality x Congenital malformations, deformations and chromosomal abnormalities	-36.5	0.009
Factors influencing health status and contact with health services x Certain infectious and parasitic diseases	-5.4	0.188
Factors influencing health status and contact with health services x Neoplasms	99.4	0
Factors influencing health status and contact with health services x Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	148.6	0
Factors influencing health status and contact with health services x Mental and behavioural disorders	-2.1	0.424
Factors influencing health status and contact with health services x Diseases of the nervous system	-44.2	0
Factors influencing health status and contact with health services x Diseases of the eye and adnexa	-21.2	0
Factors influencing health status and contact with health services x Diseases of the circulatory system	58.6	0
Factors influencing health status and contact with health services x Diseases of the digestive system	-44.6	0
Factors influencing health status and contact with health services x Diseases of the skin and subcutaneous tissue	-38.5	0
Factors influencing health status and contact with health services x Diseases of the genitourinary system	98.6	0

Diagnosis count

Variable	Coefficient	Significance	Mean predicted cost
1 diagnosis	**n/a**	**n/a**	£63
2 diagnoses	169.4	0	£148
3 diagnoses	225.0	0	£192
4 diagnoses	286.1	0	£255
5 diagnoses	349.6	0	£332
6 diagnoses	414.7	0	£421
7 diagnoses	471.8	0	£510
8 diagnoses	538.8	0	£618
9 diagnoses	598.4	0	£724
10 diagnoses	706.0	0	£1,214

Attributed need variables

Variable	Coefficient	Significance
Log population variance	-5.1	0.076
% Disability Living Allowance/Personal Independence Payment	154.0	0
Potential years of life lost indicator (IMD)	-0.3	0

CCGs

Variable	Coefficient	Significance
NHS Airedale, Wharfedale and Craven CCG	21.1	0.375
NHS Ashford CCG	93.0	0.001
NHS Barking and Dagenham CCG	62.6	0.006
NHS Barnet CCG	82.6	0
NHS Barnsley CCG	-5.8	0.759
NHS Basildon and Brentwood CCG	70.8	0.003
NHS Bassetlaw CCG	-1.0	0.889
NHS Bath and North East Somerset CCG	89.5	0
NHS Bedfordshire CCG	69.5	0.001
NHS Berkshire West CCG	72.8	0.001
NHS Bexley CCG	120.1	0
NHS Birmingham and Solihull CCG	78.7	0
NHS Blackburn with Darwen CCG	21.7	0.368
NHS Blackpool CCG	78.0	0.024
NHS Bolton CCG	10.2	0.684
NHS Bradford City CCG	9.3	0.726
NHS Bradford Districts CCG	-1.6	0.948
NHS Brent CCG	88.4	0
NHS Brighton and Hove CCG	84.7	0
NHS Bristol, North Somerset and South G	71.0	0.002
NHS Bromley CCG	94.6	0

NHS Buckinghamshire CCG	96.1	0
NHS Bury CCG	38.4	0.069
NHS Calderdale CCG	8.8	0.694
NHS Cambridgeshire and Peterborough CCG	77.2	0
NHS Camden CCG	87.2	0
NHS Cannock Chase CCG	63.2	0.004
NHS Canterbury and Coastal CCG	83.9	0.002
NHS Castle Point and Rochford CCG	84.5	0.002
NHS Central London (Westminster) CCG	91.7	0
NHS Chorley and South Ribble CCG	66.7	0.029
NHS City and Hackney CCG	103.3	0
NHS Coastal West Sussex CCG	64.7	0.011
NHS Corby CCG	94.8	0
NHS Coventry and Rugby CCG	77.6	0.001
NHS Crawley CCG	84.9	0
NHS Croydon CCG	105.2	0
NHS Darlington CCG	49.2	0.096
NHS Dartford, Gravesham and Swanley CCG	88.7	0.004
NHS Derby and Derbyshire CCG	55.9	0.001
NHS Dorset CCG	95.3	0
NHS Dudley CCG	77.0	0.001
NHS Durham Dales, Easington and Sedgefi	48.4	0.096
NHS Ealing CCG	101.8	0
NHS East Berkshire CCG	91.2	0
NHS East Lancashire CCG	17.6	0.458
NHS East Leicestershire and Rutland CCG	73.6	0
NHS East Riding of Yorkshire CCG	34.5	0.09
NHS East Staffordshire CCG	73.4	0
NHS East Surrey CCG	84.9	0
NHS East and North Hertfordshire CCG	78.3	0
NHS Eastbourne, Hailsham and Seaford CC	72.2	0.005
NHS Eastern Cheshire CCG	60.2	0.005
NHS Enfield CCG	73.9	0
NHS Fareham and Gosport CCG	100.4	0
NHS Fylde and Wyre CCG	74.0	0.031
NHS Gloucestershire CCG	110.3	0
NHS Great Yarmouth and Waveney CCG	36.8	0.204
NHS Greater Huddersfield CCG	10.8	0.618
NHS Greater Preston CCG	70.0	0.027
NHS Greenwich CCG	104.0	0
NHS Guildford and Waverley CCG	79.1	0.001
NHS Halton CCG	47.1	0.09
NHS Hambleton, Richmondshire and Whitby	68.8	0.017
NHS Hammersmith and Fulham CCG	111.1	0
NHS Haringey CCG	86.8	0
NHS Harrogate and Rural District CCG	56.2	0.019
NHS Harrow CCG	96.0	0
NHS Hartlepool and Stockton-on-Tees CCG	60.6	0.044
NHS Hastings and Rother CCG	78.6	0.002
NHS Havering CCG	66.0	0.005
NHS Herefordshire CCG	75.1	0.012

NHS Herts Valleys CCG	83.0	0
NHS Heywood, Middleton and Rochdale CCG	38.8	0.064
NHS High Weald Lewes Havens CCG	73.3	0.001
NHS Hillingdon CCG	109.1	0
NHS Horsham and Mid Sussex CCG	72.4	0.001
NHS Hounslow CCG	102.9	0
NHS Hull CCG	30.0	0.158
NHS Ipswich and East Suffolk CCG	80.6	0.001
NHS Isle of Wight CCG	99.5	0.003
NHS Islington CCG	108.6	0
NHS Kernow CCG	122.6	0
NHS Kingston CCG	94.5	0
NHS Knowsley CCG	75.1	0.008
NHS Lambeth CCG	103.1	0
NHS Leeds CCG	52.6	0.011
NHS Leicester City CCG	69.9	0
NHS Lewisham CCG	101.8	0
NHS Lincolnshire East CCG	51.3	0.009
NHS Lincolnshire West CCG	54.1	0.005
NHS Liverpool CCG	81.9	0.005
NHS Luton CCG	62.5	0.004
NHS Manchester CCG	49.8	0.016
NHS Mansfield and Ashfield CCG	58.3	0.005
NHS Medway CCG	52.1	0.049
NHS Merton CCG	110.8	0
NHS Mid Essex CCG	81.2	0.001
NHS Milton Keynes CCG	79.9	0.001
NHS Morecambe Bay CCG	68.6	0.058
NHS Nene CCG	100.4	0
NHS Newark and Sherwood CCG	41.1	0.031
NHS Newcastle Gateshead CCG	55.6	0.061
NHS Newham CCG	77.8	0
NHS North Cumbria CCG	63.8	0.097
NHS North Durham CCG	45.0	0.123
NHS North East Essex CCG	52.8	0.034
NHS North East Hampshire and Farnham CC	66.4	0.004
NHS North East Lincolnshire CCG	53.9	0.01
NHS North Hampshire CCG	84.2	0
NHS North Kirklees CCG	25.8	0.268
NHS North Lincolnshire CCG	58.0	0.003
NHS North Norfolk CCG	78.1	0.001
NHS North Staffordshire CCG	71.7	0.003
NHS North Tyneside CCG	50.5	0.103
NHS North West Surrey CCG	90.9	0
NHS Northern, Eastern and Western Devon	136.4	0
NHS Northumberland CCG	53.7	0.087
NHS Norwich CCG	66.7	0.005
NHS Nottingham City CCG	68.5	0
NHS Nottingham North and East CCG	58.6	0.002
NHS Nottingham West CCG	69.3	0
NHS Oldham CCG	33.8	0.106

NHS Oxfordshire CCG	80.7	0
NHS Portsmouth CCG	103.8	0
NHS Redbridge CCG	71.5	0.001
NHS Redditch and Bromsgrove CCG	85.2	0
NHS Richmond CCG	103.5	0
NHS Rotherham CCG	18.4	0.328
NHS Rushcliffe CCG	54.8	0.004
NHS Salford CCG	51.8	0.015
NHS Sandwell and West Birmingham CCG	76.7	0.001
NHS Scarborough and Ryedale CCG	57.3	0.009
NHS Sheffield CCG	52.6	0.002
NHS Shropshire CCG	69.4	0.012
NHS Somerset CCG	92.6	0
NHS South Cheshire CCG	41.1	0.101
NHS South Devon and Torbay CCG	151.5	0
NHS South East Staffordshire and Seisdo	67.1	0.001
NHS South Eastern Hampshire CCG	94.9	0
NHS South Kent Coast CCG	88.3	0.001
NHS South Lincolnshire CCG	66.9	0.001
NHS South Norfolk CCG	75.1	0.001
NHS South Sefton CCG	74.2	0.011
NHS South Tees CCG	71.7	0.021
NHS South Tyneside CCG	31.9	0.337
NHS South Warwickshire CCG	75.6	0.005
NHS South West Lincolnshire CCG	59.2	0.002
NHS South Worcestershire CCG	94.3	0
NHS Southampton CCG	107.4	0
NHS Southend CCG	83.6	0.003
NHS Southport and Formby CCG	44.1	0.148
NHS Southwark CCG	105.2	0
NHS St Helens CCG	45.6	0.101
NHS Stafford and Surrounds CCG	61.5	0.009
NHS Stockport CCG	57.1	0.003
NHS Stoke on Trent CCG	76.5	0.002
NHS Sunderland CCG	54.8	0.064
NHS Surrey Downs CCG	89.0	0
NHS Surrey Heath CCG	73.1	0.002
NHS Sutton CCG	99.7	0
NHS Swale CCG	52.2	0.047
NHS Swindon CCG	84.4	0
NHS Tameside and Glossop CCG	21.3	0.371
NHS Telford and Wrekin CCG	68.9	0.012
NHS Thanet CCG	74.0	0.008
NHS Thurrock CCG	73.6	0.002
NHS Tower Hamlets CCG	81.0	0
NHS Trafford CCG	45.5	0.029
NHS Vale Royal CCG	35.4	0.145
NHS Vale of York CCG	46.5	0.025
NHS Wakefield CCG	22.0	0.35
NHS Walsall CCG	57.0	0.017
NHS Waltham Forest CCG	80.1	0

NHS Wandsworth CCG	101.8	0
NHS Warrington CCG	52.6	0.053
NHS Warwickshire North CCG	42.0	0.088
NHS West Cheshire CCG	38.3	0.205
NHS West Essex CCG	80.5	0
NHS West Hampshire CCG	91.8	0
NHS West Kent CCG	77.0	0.001
NHS West Lancashire CCG	39.4	0.174
NHS West Leicestershire CCG	69.7	0
NHS West London CCG	103.2	0
NHS West Norfolk CCG	75.1	0.001
NHS West Suffolk CCG	75.2	0.001
NHS Wigan Borough CCG	62.0	0.011
NHS Wiltshire CCG	92.3	0
NHS Wirral CCG	36.1	0.233
NHS Wolverhampton CCG	57.8	0.008
NHS Wyre Forest CCG	97.4	0

Providers

Variable	Coefficient	Significance
Northumbria Healthcare NHS Foundation Trust	24.4	0.62
Alder Hey Children's NHS Foundation Trust	159.6	0
Barking, Havering and Redbridge University Hospitals NHS Trust	132.4	0.001
St George's University Hospitals NHS Foundation Trust	98.6	0.006
Barts Health NHS Trust	139.3	0
Dorset County Hospital NHS Foundation Trust	26.2	0.488
Renal Services UK Ltd	-481.9	0.893
Southport and Ormskirk Hospital NHS Trust	339.9	0.031
Royal Papworth Hospital NHS Foundation Trust	142.8	0.013
Cambridge University Hospitals NHS Foundation Trust	103.2	0.001
Diver Clinic (Atlantic Enterprises)	4735.6	0.412
Royal Brompton & Harefield NHS Foundation Trust	110.7	0.006
South Tees Hospitals NHS Foundation Trust	76.6	0.075
Great Western Hospitals NHS Foundation Trust	26.6	0.475
Taunton and Somerset NHS Foundation Trust	51.3	0.167
The Princess Alexandra Hospital NHS Trust	98.0	0.009
University Hospitals Bristol NHS Foundation Trust	115.5	0.001
The Royal Wolverhampton NHS Trust	122.0	0.001
North Cumbria University Hospitals NHS Trust	103.3	0.093
Gloucestershire Hospitals NHS Foundation Trust	66.2	0.097
The Royal Marsden NHS Foundation Trust	25.3	0.571
University Hospitals of North Midlands NHS Trust	113.2	0.003
Central Manchester University Hospital	171.6	0
Luton and Dunstable University Hospital NHS Foundation Trust	92.5	0.029
Walsall Healthcare NHS Trust	70.2	0.201
South Warwickshire NHS Foundation Trust	31.4	0.603
Birmingham Community Healthcare NHS Foundation Trust	145.3	0.479

George Eliot Hospital NHS Trust	120.0	0.106
Surrey and Sussex Healthcare NHS Trust	74.3	0.083
Lancashire Teaching Hospitals NHS Foundation Trust	100.1	0.074
Bedford Hospital NHS Trust	86.0	0.082
Heatherwood and Wexham Park Hospitals	-19.2	0.854
North Tees and Hartlepool NHS Foundation Trust	112.6	0.077
Queen Victoria Hospital NHS Foundation Trust	232.1	0.332
University Hospitals Birmingham NHS Foundation Trust	101.9	0.005
Leeds Teaching Hospitals NHS Trust	168.3	0
South Tyneside NHS Foundation Trust	155.8	0.083
Poole Hospital NHS Foundation Trust	-32.9	0.389
Great Ormond Street Hospital for Children NHS Foundation Trust	107.7	0.005
The Queen Elizabeth Hospital, King's Lynn, NHS Foundation Trust	22.8	0.569
East Lancashire Hospitals NHS Trust	133.0	0.011
University Hospitals of Leicester NHS Trust	105.8	0.002
Medway NHS Foundation Trust	162.6	0.018
Worcestershire Acute Hospitals NHS Trust	7.1	0.861
Blackpool Teaching Hospitals NHS Foundation Trust	109.5	0.039
East Suffolk and North Essex NHS Foundation Trust	81.1	0.07
Northern Devon Healthcare NHS Trust	-49.0	0.265
Yeovil District Hospital NHS Foundation Trust	-16.7	0.659
North Cumbria Integrated Care NHS Foundation Trust	246.9	0.779
County Durham and Darlington NHS Foundation Trust	100.8	0.044
Mid Yorkshire Hospitals NHS Trust	18.3	0.742
Hampshire Hospitals NHS Foundation Trust	36.9	0.348
East Cheshire NHS Trust	10.5	0.94
Royal Free London NHS Foundation Trust	135.0	0
Bradford Teaching Hospitals NHS Foundation Trust	134.4	0.011
Frimley Health NHS Foundation Trust	117.4	0.008
Royal National Orthopaedic Hospital NHS Trust	-204.0	0.182
Chesterfield Royal Hospital NHS Foundation Trust	-159.0	0.006
Birmingham Women's and Children's NHS Foundation Trust	135.4	0
Sheffield Children's NHS Foundation Trust	182.7	0
Aspen - Nova Healthcare	218.0	0.94
Livewell Southwest	-198.6	0.345
Countess of Chester Hospital NHS Foundation Trust	132.2	0.031
North Middlesex University Hospital NHS Trust	182.7	0
Buckinghamshire Healthcare NHS Trust	19.7	0.603
University Hospital of South Manchester	128.8	0.002
Mid Cheshire Hospitals NHS Foundation Trust	173.3	0.097
Norfolk and Norwich University Hospitals NHS Foundation Trust	120.2	0
Northern Lincolnshire and Goole NHS Foundation Trust	52.7	0.214
North West Anglia NHS Foundation Trust	78.1	0.018
Nottingham University Hospitals NHS Trust	173.6	0
Harrogate and District NHS Foundation Trust	72.8	0.13
St Peter's Andrology Centre	-2626.9	0.022
Burton Hospitals NHS Foundation Trust	-22.9	0.633
Paul Strickland Scanner Centre	-1566.1	0.392

Maidstone and Tunbridge Wells NHS Trust	125.3	0.002
Sheffield Teaching Hospitals NHS Foundation Trust	157.4	0
City Hospitals Sunderland NHS Foundation Trust	63.0	0.178
Lewisham and Greenwich NHS Trust	2.9	0.957
Kettering General Hospital NHS Foundation Trust	13.9	0.724
University Hospitals Plymouth NHS Trust	86.5	0.05
Milton Keynes University Hospital NHS Foundation Trust	64.3	0.166
Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust	135.0	0.043
University of Southampton Auditory Implant Service	2240.4	0.001
Stockport NHS Foundation Trust	-36.7	0.705
Liverpool University Hospitals NHS Foundation Trust	226.1	0.011
Weston Area Health NHS Trust	7.6	0.866
Staffordshire And Stoke on Trent Partnership NHS Trust	121.7	0.88
Cambridgeshire Community Services NHS Trust	-128.7	0.876
Royal Surrey County Hospital NHS Foundation Trust	62.1	0.145
Wye Valley NHS Trust	-12.9	0.924
Cardiff & Vale University LHB	-5607.0	0.363
Imperial College Healthcare NHS Trust	103.2	0.003
United Lincolnshire Hospitals NHS Trust	136.5	0
The Robert Jones and Agnes Hunt Orthopaedic Hospital NHS Foundation Trust	49.7	0.697
Fresenius Kabi Ltd	-4504.4	0.696
The Christie NHS Foundation Trust	182.7	0
The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	27.4	0.463
Hull University Teaching Hospitals NHS Trust	169.7	0
University Hospitals of Morecambe Bay NHS Foundation Trust	89.4	0.174
Sandwell and West Birmingham Hospitals NHS Trust	69.1	0.107
Whittington Health NHS Trust	26.1	0.734
The Dudley Group NHS Foundation Trust	-49.0	0.275
Pennine Acute Hospitals NHS Trust	114.0	0.004
Salford Royal NHS Foundation Trust	83.2	0.064
St Helens and Knowsley Teaching Hospitals NHS Trust	119.5	0.074
The Royal Hospital for Neuro-Disability	-550.3	0.516
Brighton and Sussex University Hospitals NHS Trust	70.3	0.047
Portsmouth Hospitals NHS Trust	30.1	0.409
Basildon and Thurrock University Hospitals NHS Foundation Trust	137.1	0.005
Royal Devon and Exeter NHS Foundation Trust	-12.2	0.776
University College London Hospitals NHS Foundation Trust	94.0	0.008
Circle - Nottingham NHS Treatment Centre	-1389.1	0.08
Northampton General Hospital NHS Trust	44.4	0.25
Torbay and South Devon NHS Foundation Trust	-49.4	0.389
Southend University Hospital NHS Foundation Trust	83.2	0.125
West Suffolk NHS Foundation Trust	-43.4	0.356
Salisbury NHS Foundation Trust	-6.6	0.859
University Hospitals Coventry And Warwickshire NHS Trust	90.3	0.016
Betsi Cadwaladr University LHB	349.2	0.641
North Bristol NHS Trust	130.5	0.003

King's College Hospital NHS Foundation Trust	98.7	0.007
Hinchinbrooke Health Care NHS Trust	-299.4	0.146
Sherwood Forest Hospitals NHS Foundation Trust	-6.4	0.944
James Paget University Hospitals NHS Foundation Trust	159.2	0.011
Charing Cross Holiday Dialysis Trust	6732.6	0.33
Ashford and St Peter's Hospitals NHS Foundation Trust	96.0	0.15
Gateshead Health NHS Foundation Trust	85.7	0.041
Guy's and St Thomas' NHS Foundation Trust	117.7	0.001
The Newcastle Upon Tyne Hospitals NHS Foundation Trust	137.6	0.001
Isle of Wight NHS Trust	95.8	0.416
Western Sussex Hospitals NHS Foundation Trust	52.1	0.3
The Walton Centre NHS Foundation Trust	29.8	0.608
Croydon Health Services NHS Trust	92.0	0.238
Tameside and Glossop Integrated Care NHS Foundation Trust	459.0	0.005
Barnsley Hospital NHS Foundation Trust	264.1	0.047
University Hospital Southampton NHS Foundation Trust	88.0	0.012
Wirral University Teaching Hospital NHS Foundation Trust	9.7	0.927
York Teaching Hospital NHS Foundation Trust	95.1	0.017
University Hospitals of Derby and Burton NHS Foundation Trust	69.1	0.049
The Huntercombe Group	3322.2	0
Heart of England NHS Foundation Trust	74.6	0.043
Bolton NHS Foundation Trust	256.5	0.004
Dartford and Gravesham NHS Trust	11.0	0.914
Liverpool Women's NHS Foundation Trust	-248.8	0.213
The Royal Orthopaedic Hospital NHS Foundation Trust	-67.4	0.836
London North West University Healthcare NHS Trust	90.2	0.042
The Clatterbridge Cancer Centre NHS Foundation Trust	270.1	0
Homerton University Hospital NHS Foundation Trust	-16.8	0.786
Royal Cornwall Hospitals NHS Trust	-48.2	0.287
East and North Hertfordshire NHS Trust	94.4	0.006
Wrightington, Wigan and Leigh NHS Foundation Trust	40.8	0.698
Warrington and Halton Hospitals NHS Foundation Trust	15.8	0.892
Mid Essex Hospital Services NHS Trust	72.6	0.077
Oxford Fertility Unit	3422.5	0.127
Glenside Manor Healthcare Services Limited	1350.2	0.733
Royal United Hospitals Bath NHS Foundation Trust	11.8	0.743
Liverpool Heart and Chest Hospital NHS Foundation Trust	113.8	0.116
Central and North West London NHS Foundation Trust	-150.4	0.734
Epsom and St Helier University Hospitals NHS Trust	106.6	0.037
K C Holiday Dialysis Centre	2371.0	0.373
West Hertfordshire Hospitals NHS Trust	16.8	0.74
Chelsea and Westminster Hospital NHS Foundation Trust	14.0	0.71
B Braun Medical Ltd	2056.9	0.295
Shrewsbury and Telford Hospital NHS Trust	83.6	0.108
The Rotherham NHS Foundation Trust	77.4	0.435
Diving Disease Research Centre	-10962.9	0.159
Moorfields Eye Hospital NHS Foundation Trust	-101.8	0.171
The Hillingdon Hospitals NHS Foundation Trust	-55.8	0.472
Calderdale and Huddersfield NHS Foundation Trust	-43.2	0.615

Royal Berkshire NHS Foundation Trust	3.2	0.932
East Sussex Healthcare NHS Trust	21.7	0.631
East Kent Hospitals University NHS Foundation Trust	38.9	0.379
Oxford University Hospitals NHS Foundation Trust	165.9	0
Royal Liverpool and Broadgreen University Hospitals NHS Trust	86.5	0.199
Kingston Hospital NHS Foundation Trust	38.5	0.68
Airedale NHS Foundation Trust	37.9	0.531

Annex F: Frequently asked questions on needs-based allocations for specialised services

Governance and quality assurance

1. **Who oversees the development of target allocations?**

   The NHS England Board is advised on target allocations by the Advisory Committee on Resource Allocation (ACRA). The committee is made up of clinicians, academics, including health economists, NHS managers and finance experts, and representatives of central and local government. The committee, and its predecessors, originally the Resource Allocation Working Party (RAWP), has been providing advice since 1974.

2. **How do you quality assure the targets?**

   Each component of the target, as well as the final targets and actual allocations, goes through a range of quality assurance processes consistent with standards set out in the Macpherson Review of Quality Assurance of Business-Critical Models and the associated AQuA book. This includes detailed investigation of apparently anomalous results. The quality assurance includes:

   i. peer review
   ii. independent internal review
   iii. clinical review via representatives from the specialised commissioning clinical reference groups (CRGs)
   iv. independent methodological review (ACRA).

3. **How will you evaluate the shift to needs-based target allocations for specialised services?**

It is difficult to separate the specific impact of the allocations from the impact of other management actions to improve services. However academic studies have shown that this approach can improve the equity of outcomes for individuals. See, for example, The impact of NHS resource allocation policy on health inequalities in England 2001-11: longitudinal ecological study | The BMJ. That work underpins the assumption that allocating according to need will reduce health inequalities.

For the proposed shift towards needs-based allocation specifically for specialised services, given that it is taking place in the context of and to support integration of commissioning of specialised services with non-specialised, evaluation should assess the impact of driving system allocations overall towards target. There is academic research underway to achieve better understanding and quantification of unmet need (https://fundingawards.nihr.ac.uk/award/NIHR130258); once that's completed we should then be able to track the degree of unmet need over time and see if it reduces.

Rationale

4. **Why is this change being undertaken now?**

There are two principal aims in estimating relative need for specialised services: equity and efficiency.

i. **Equity.** Government's mandate to NHS England sets the expectation of basing allocations on the principle of equal access for equal need.[17] Estimating relative need for different populations in respect of specialised services, coupled to the advent of population-based allocations for these services converging over time towards needs-based target allocation, is a means to achieving equal access.

ii. **Efficiency.** Comparing existing population-based allocations to needs-based targets enables ICSs, initially working with NHS England, to improve services by considering the best balance of services along a patient's pathway (from prevention to treatment of severe disease). The extent of opportunities for such

[17] NHS mandate 2018 to 2019 - GOV.UK (www.gov.uk)

pathway optimisation, and the scope for other efficiency gains can be revealed by benchmarking utilisation of services against need.

5. **Will there be scope and reward for ICBs' to look at preventative services that alleviate need for more specialist services?**

   It is envisaged that commissioners responsible for commissioning specialised services for a given population will have flexibility to optimise resource use along the service pathway, spending on preventative and other upstream services if that is the best way to secure better health outcomes for patients.

   Regarding whether financial reward will accrue to the ICB, needs-based target allocations, to which actual allocations will converge over time, will be determined by estimated need. If actual need falls short of this due to effective investment upstream and NHS England is satisfied that delegated responsibility for these services is being discharged properly, the ICB will still receive the same allocation and be free to reinvest the surplus in other services.

6. **If NHS England delegates funding but retains accountability for specialised services, how do ICBs benefit from efficiency delivered?**

   It is expected that the delegated allocation for specialised services will not be adjusted period on period to take account of variations in actual spend; i.e. it is expected ICBs will retain the benefit of any efficiencies that they deliver.

7. **Won't a redistribution of money just mean some patients suffer worse health services? The development of specialised services over the last decade has often involved important investment in improved service quality. Rollout of improved services is usually uneven, leading to higher costs in some areas than others. While I understand the need to move funding within a limited budget from well-funded and well-served areas to less well-funded and less well-served areas, will this just mean in the future the better served areas suffer worse service and worse outcomes?**

   Needs-based allocations need not compromise the quality of service of those areas that are currently over target for the following reasons:

   i. To avoid sharp shocks to budgets, actual allocations will be derived from target allocations through convergence policy. This policy will moderate the speed of

movement towards target, ensuring that the minimum growth for those furthest over target is set at a level that allows stability of services and creates confidence for medium term planning.[18]

ii. In parallel, efforts to understand what underlies distance from target – the difference between actual spend on specialised services and the target allocation – will enable identification of areas of over/underspend (discussed in section 3.2, above). In some cases, need may be avoided by improving poor or underfunded primary or secondary care services. In other cases, benchmarking may point to scope for improvements in technical efficiency or economy.

iii. Where overspend is attributable to relatively high quality of service or to broader access to services, delivered cost-effectively, that would be reason to restrict convergence toward target allocation to what can be achieved through allocation of real increases in funding, so that movement towards target can be achieved by levelling up.

iv. Where benchmarking reveals lower eligibility thresholds for treatment in some areas that are overfunded relative to target, it is possible that in some cases this represents cost-ineffective care.

Scope of services included

8. **What is the range of services to be included in population- based allocations and convergence on needs-based target allocations?**

Needs-based target allocations will be set for the basket of services that is to be subject to integrated commissioning on a population basis (whether through delegation or other joint commissioning arrangements).

i. The presumption is that all services except **highly specialised services** and the **Cancer Drug Fund (CDF)** and the **Innovative Medicine Fund (IMF)** will be subject to integrated commissioning.

ii. Highly specialised services will remain centrally commissioned as services with few patients at high cost per patient carry a naturally higher level of volatility that can more easily be managed nationally.

[18] See Technical Guide to Allocations (england.nhs.uk), section 9, for the principles applied to pace of change for the '19/20 allocation to CCGs.

iii. The CDF and IMF will remain centrally managed in order to manage the risk and oversight of the rollout of new drugs.

9. **This engagement is focused on specialised physical health services. When will MH services be included?**

We hope to add MH models of need in the course of 2022, to inform allocations from April 2024, aligned to the end of current contracts with MH provider collaboratives.

10. **How does the model take account of the fact that the scope of specialised services varies over time due to innovation?**

The scope of specialised services can change over time with the introduction of new services. Generally, on introduction, these services will not materially affect the appropriate allocation to ICS populations, given: the small scale of new innovations relative to the overall budget; that common factors (age-related morbidity adjusted for deprivation) drive need for most specialised services; and the limited pace of convergence towards target allocations. However, over time, innovations cumulate. This, together with demographic changes, necessitates periodic remodelling of need (see FAQs 30-32, on Model Renewal). Exceptionally, there may be need for *ad hoc* allocations.

11. **Won't the modelling quickly become out of date as the definition of which services are specialised changes over time, particularly following integration of specialised commissioning with ICSs?**

The integration of specialised commissioning with ICS commissioning will not end the distinction between specialised and non-specialised services, with specialised commissioning of in-scope services being delegated but not devolved from April 2023. Over time, the relative weight of different specialised services may change. This will affect the remodelling of the geographical distribution of need that will be undertaken every few years. This issue will be monitored and if change is rapid, an earlier remodelling may be undertaken if required. This approach mirrors the established approach taken for allocations for general services.

12. **How does the model take account of the fact that the range of Services deemed to be specialised varies between places, as regional commissioning hubs have set aside the Identification Rules aside in some areas, and as the**

Identification Rules themselves lead to a broader scope of some specialised services in areas in which Provider Eligibility List (PEL) providers are located?

The model seeks to assess underlying relative need for specialised services, assuming that the right total sum is dedicated to specialised services across the country. In this it properly mirrors the approach taken in the general and acute model. It is true that an area that has a broader scope of services funded as specialised may for that reason appear to be over-spent relative to modelled need; by the same token, however, it should appear under-spent on non-specialised services relative to the target allocation for those services. It is therefore important that Distance from Target Allocation is reviewed in tandem for the specialised and non-specialised models, in the context of careful *ex post* examination of reasons for variation in spending.

Destabilisation risk

13. **Specialised services commissioning was not delegated to CCGs in 2013 in part because the budgetary risk was thought too great for them to bear; how are ICSs to handle this risk?**

    It is intended that commissioning of specialised services will move over time towards a needs-based allocation to ICS populations, with commissioning being delegated to ICSs. The first step, delegation to ICSs of population based allocations, in shadow form from April ’22 with full delegation phased in from April ’23, creates budgetary risk for ICSs arising from year to year volatility in demand for specialised services. (The transition towards needs-based allocation will little affect this risk.) However:

    i. The extent to which ICSs can handle volatility will exceed that of CCGs; their greater scale gives them more resilience to manage volatility in demand. There were around three hundred CCGs when specialised commissioning was centralised in 2013; there are 42 ICSs.

    ii. Furthermore, for those services that are more appropriately commissioned on a multi-ICS footprint, risk-sharing arrangements between ICSs are likely to be developed, with ICSs working together in Joint Committees.

iii. Providers will be contracted on a largely fixed basis within financial years under the *aligned payment incentives* approach being introduced as part of the NHS Payment Scheme. The incentives in the system are different than they were under Payment by Results in 2013, mitigating commissioner risk.

14. **How will you assess system and provider impact? How are you evaluating the impact that moving to a needs-based allocation from an historical cost allocation will have on systems (ICSs) and providers?**

    The impact assessment will be conducted in the context of setting convergence policy.

    i. Convergence policy will set the speed of movement towards target.

    ii. Convergence policy for specialised and non-specialised services will be developed in tandem, so that overall system capacity for change is respected.

    iii. It is intended that convergence policy will also take account of provider impact, constructed on the basis of explicit assumptions regarding the likely shift in demand for services as access equity is achieved.

15. **Is there a risk that money moved to areas that are currently under-utilising specialised services (relative to modelled need) will be used to increase funding for non-specialised services, and that consequently overall demand from specialised centres will shrink rendering the centres financially and clinically unsafe?**

    There is such a risk. It is mitigated by the following considerations:

    i. Specialised commissioning is being delegated but not devolved to ICSs. NHS England will remain accountable for delivery of specialised services; this means that it has oversight of all aspects of the quality of specialised services delivered to ICS populations. NHS England regions will routinely monitor performance to identify and address budgetary risk early.

    ii. ICSs with delegated responsibility for commissioning specialised services will be accountable for providing access to these services in line with need and with the service specification.

    iii. We intend to use variation analyses and benchmarking to highlight where populations appear to be underserved by specialised services, which should

provide ICSs with the information they need to use additional funding to make good shortfall.

iv. Ultimately, the purpose of integration and delegation is to enable pathway optimisation (see Glossary, Annex G). If an ICS determines that it is in patients' interests for example to direct extra funding upstream to pre-empt need for specialised services, and if that leads to a drop in specialised activity, that would be a successful outcome, notwithstanding that the specialised service would have to adapt to a gradual decline in scale of operation.

Model specification

16. **What approach do you take to setting target allocations?**

There are separate steps involved in all the allocations models, including that for specialised services:

i. We look at the share of the national population in each area, based on GP registered lists, as the starting point for each area's target allocation or 'fair share'.

ii. We then adjust each area's share of total resources according to our estimates of whether their relative need for healthcare is higher or lower than the average.

iii. To do this, we use a set of statistical formulae to estimate local healthcare needs. These are built up from data on the utilisation of services, and supplemented with an adjustment for unmet need. This approach ensures that we are allocating resources according to the need for healthcare, whether that need is met by existing services or not. The unmet need adjustment is combined with the health inequalities adjustment to help meet our objective to reduce avoidable health inequalities.

17. **Why is the model based on data on the utilisation of hospital services and not the prevalence of disease?**

In a nutshell, we lack the information to base allocation on prevalence directly, so instead we exploit utilisation data linked to patient-level information to deduce what characteristics generally lead to specialised service use, and estimate relative need on the basis of the geographical distribution of those characteristics:

i. Ideally, we would use a bottom up approach to building fair shares, by estimating what care ought to be provided at what cost in different parts of the country. Unfortunately, this is not currently attainable. We lack detailed data on: the prevalence and incidence of disease in England and its severity; and evidence of what the most efficient and effective treatment is that ought to be provided and at what cost.

ii. We therefore make the most of the data available to us at the patient level, but we are careful to use information where we can that represents health needs rather than simply counting activity levels. The patient-level data we use allows us to build a model that can predict costs at the individual, and it draws on information most closely linked to a patient's health needs, i.e. diagnostic information rather than, for example, number or type of interactions with clinical teams.

18. **Need for a specialised service might be absolute or it might be a consequence of having to compensate for inadequate primary/secondary services. How does the model manage that dynamic?**

The personal diagnostic histories that drive the model estimates of need will pick up underlying need for specialised services. As a consequence, those areas where poor upstream services are creating additional need will find themselves using more resources than their target, and will be challenged over time to invest more upstream to address that issue. It is a virtue of introducing needs-based target allocation alongside integration of commissioning between specialised and non-specialised services that the integrated commissioners will be in a position to optimise services along the pathway in response to such a challenge.

Note however that poor-quality primary and secondary services can also lead to **reduced** demand for specialised services: need may go unidentified and consequently unmet (leading in some cases to premature mortality). Such need may be undiagnosed and therefore missing from the model. Separate work to investigate this is under way as part of ACRA's review of undiagnosed need and health inequalities (as discussed in section 3.1, vii, above).

19. **The historical diagnoses used as need variables are derived from inpatient data; how will need for services primarily provided in outpatient settings be captured?**

For services we can test, it appears that patients using outpatient based services will nonetheless have relevant diagnoses on their inpatient records (perhaps relating to unrelated admissions). Nevertheless, on the forward work plan we propose to explore linking clinical registry data that will include diagnoses registered in outpatient settings (section 3.1, iii).

20. **Why is the model based on commissioner expenditure (in the PLCM) rather than provider-costs? Will it be invalidated as expenditure moves away from a price x activity (PbR) basis?**

Ideally the model would be built using cost-weighted activity as the measure of persons' specialised resource utilisation, with the costs-weights derived from estimates of the efficient cost of providing each service. This is the approach taken in estimating the General and Acute allocations model (with most services cost-weighted using Tariff, which in turn is derived from reference costs). In due course, such cost-weights might be derivable for specialised services from the Patient Level Information Costings System (PLICS). However, the coverage and reliability of PLICS is not yet adequate for this purpose (and few specialised services by value are Tariffed based on reference costs).

Instead, we use commissioner expenditure on different services as a proxy for their relative efficient-cost, on the assumption that the ratio of aggregate expenditure to costs is unlikely to vary much from service to service. It is true that for many services the amount spent on a given service depends on the local pricing and counting arrangements agreed between NHS England regional teams and service providers, the generosity of which may vary from place to place. However, the modelling takes this into account through the introduction of supply variables for each CCG and for each provider, so that systematic over- or under-pricing will be recognised and excluded from the estimation of relative needs indices.

Given that PLCM data is being used in the model only as a proxy for assessing the relative resources used in providing different services, the shift away from activity-based payment of providers will not in any way invalidate it. How commissioners choose to pay their service providers is totally independent of the determination of the funding allocation within which they conduct their commissioning, and it is only the latter that is estimated by the allocations model.

21. **What independent academic research is used in the target allocations formula?**

    The allocations methodology has long been based on independent academic advice. The key methodological approach that now underpins our allocations formulae is 'person-based resource allocation' (PBRA) developed during the early 2000s by academics at the Nuffield Trust, University of York, University of Manchester, New York University, Health Dialog and the London School of Hygiene and Tropical Medicine. https://www.nuffieldtrust.org.uk/research/person-based-resource-allocation-new-approaches-to-estimating-commissioning-budgets-for-gp-practices and developed for mental health services by a team from the University of Manchester (https://webarchive.nationalarchives.gov.uk/20151108155125/https:/www.england.nhs.uk/wp-content/uploads/2013/08/ann-c1-res-all-mh.pdf).

22. **Where can I find out more detail about the methodology?**

    Details of the CCG allocations methodology, on which the specialised modelling is based, is available on the NHS England and NHS Improvement allocations website (https://www.england.nhs.uk/allocations/). This includes an excel tool which allows you to see the impact of all target allocation changes at a CCG, ICS and regional level, as well as further technical guidance.

23. **Can I see the underlying calculations? Is there an equivalent of the exposition book from PCT allocations?**

    The inputs to target allocations, including the population estimates and the need estimates resulting from the formulae, are set out in the spreadsheets accompanying the technical guidance to allocations. Those spreadsheets include notes and, where feasible, formulae and Stata code to show how the targets are constructed. In addition, the econometric modelling that underpins the formulae is described in detail in the research reports published in the same place (https://www.england.nhs.uk/allocations/).

Patients moving near care providers

24. **Does the model take account of people who move close to care providers?**

We lack evidence of such a halo effect, and it is plausible that it is rare: for acute illnesses people are unlikely to move closer to care; and for longer term conditions, with few exceptions, people are more likely to move near family support. However, we would be interested if there is any evidence of the extent of this phenomenon for different conditions. We would take the following approach to addressing it:

i. The modelling will take account of the resource needs of those who have moved close to a hospital so long as their diagnostic record reveals that need.

ii. In the research programme, we intend to explore whether the diagnostic categories can be refined better to capture those specific groups for whom this is more likely, in particular those with long term conditions on clinical registries. (Section 3.1, iii.)

iii. Where evidence emerges of a halo effect, we can ensure that relevant diagnoses are salient in the model inputs. (However, for some services it may be more appropriate for funds to be allocated to places where need arises originally.)

Missing from the model

COVID-19

25. **How does the model take account of the impact of COVID-19 and its aftermath (including elective recovery and long COVID) on relative need for different specialised services and on their relative cost?**

The model is based on pre-COVID data; no adjustment is made for COVID-19 related costs. This is correct for the time being, as COVID-19 costs, and recovery-funding to address backlog demand, are met by separate *ad hoc* allocations.

Future models will take into account long COVID and any enduring impact on relative costs related to infection prevention etc.

Health inequalities and unmet need

26. **How are you addressing health inequalities?**

A further adjustment is made to the modelling results as part of the target allocation calculation. This reflects our objectives to tackle health inequalities and address unmet need for health services. This adjustment is based on data on avoidable

mortality at a small area level, aggregated up to system level, and thus takes account of inequalities within as well as between systems.

27. **Why are only mortality data used in the health inequalities adjustment when health inequalities are multi-dimensional?**

    We recognise that health inequalities are a complex and multi-dimensional issue. ACRA's view is that avoidable mortality is a good proxy for a range of issues relating to health inequalities including deprivation and morbidity as well as being a health outcome measure in its own right. The forward work programme includes internal analysis and external academic work to review this approach and refresh it should better data and methodologies be available.

28. **The model is driven largely by individuals' diagnoses received in secondary care. How then will you account for the many people who miss being diagnosed either due to ignoring invitations or because they are waiting for diagnostics?**

    The model should identify likely need on the basis of historical association of use with morbidity, so it should reveal where specialist need is not currently being diagnosed as expected. However, there may be groups of patients whose need is systematically missing from the record. This is the subject of the work on the health inequalities and unmet need adjustment described in the Introduction (section 1.1) and referenced in the forward work programme; see section 3.1, vi and vii.

29. **Will the modelling of need take into account the additional costs incurred in providing specialised services to remote communities?**

    This is part of the forward work programme; see section 3.1, iv.

Timing of implementation and renewal

30. **Wouldn't it be better to await the refinement of the model promised in the forward work programme?**

    The agenda for refinement of the modelling is likely to stretch indefinitely forward. ACRA views the outputs of the model as the best currently available estimate of true need. It is better to use roughly right estimates than to leave allocations completely unanchored by estimates of need.

31. **When will the model be updated?**

As required to take account of data and modelling improvements and service changes. Although modelling is continually refined, Target Allocations have typically tended to be set every 2-3 years.

32. **Under what circumstances will allocations be reopened/reviewed?**

NHS England reserves the right to change allocations in a number of specific circumstances where the financial stability of the commissioning system is challenged or it is clear that the allocations are no longer fair in their distribution to health economies. Examples of the circumstances under which the allocations will be reviewed include:

- a disproportionate financial imbalance in any part of the commissioning system
- a new government policy with additional funding creating an additional pressure in one area
- a disproportionate increase or decrease in the share of the national population caused by a change to underlying population statistics or changes in the pattern of GP registration
- a disproportionate increase or decrease in the need-weighted share of the total need-weighted population caused by a change to underlying age structures or populations or relative levels of deprivation
- a new national contract or pay award established by the government that requires additional funding or redistribution of resources
- the impact of public sector pensions revaluation and the need to distribute this funding to providers
- any other change in mandate funding.

Annex G: Glossary

Advisory Committee for Resource Allocation (ACRA): an independent, expert committee with a remit to provide recommendations and advice on the formulae that inform target budgetary allocations for local commissioners of health services. Its terms of reference can be found here: https://www.england.nhs.uk/publication/advisory-committee-on-resource-allocation-acra-terms-of-reference/

Clinical commissioning groups (CCGs): NHS organisations established as part of the Health and Social Care Act in 2012. CCGs are groups of general practices (GPs) which come together in each area in England to commission the best services for their patients and population.

General and acute services: A funding stream within the allocations model for CCGs, representing hospital and community services. Sometimes referred to as secondary care.

Gravity weighting: Giving weight according to the inverse of the square of the distance: in the same way that gravity is inversely proportional to the square of the distance between two bodies, so the likely impact of proximity to a healthcare facility on utilisation diminishes with the square of the distance.

Indices of Multiple Deprivation (IMD): Statistics measuring and ranking relative deprivation between small areas (LSOAs – see below) in England. They are published by the Department for Levelling Up, Housing & Communities.

Integrated Care Systems (ICSs): Partnerships between the organisations that meet health and care needs across an area, to co-ordinate services and to plan in a way that improves population health and reduces inequalities between different groups.

Middle/lower layer super output areas (MSOA/LSOA): Geographical areas calculated by the ONS that can be used for data collection (e.g. comparing mortality between areas). There are currently 7,201 MSOAs and 34,753 LSOAs across England and Wales.

Primary care: A funding stream within the allocations model to CCGs, representing first-point of contact services such as GP, health visitor, optician and dentist services.

Primary care trusts (PCTs): Administrative bodies responsible for commissioning primary, community, and secondary healthcare providers in England. Replaced by CCGs in 2013.

Quality outcomes framework (QOF): a measurement of disease prevalence and care quality achievement rates across primary care.

Market Forces Factor (MFF): is an estimate of unavoidable cost differences incurred in providing health services from different geographical locations. The MFF is used to adjust resource allocations in the NHS in proportion to these cost differences, so that patients are neither advantaged nor disadvantaged by the relative level of unavoidable costs in different parts of the country.

Pathway optimisation: the achievement of the optimal balance of healthcare interventions along the trajectory of healthcare need in relation to a particular condition from prevention through case finding and early intervention through to treatment for more and more severe disease. Optimality is here conceptualised as the set of service interventions that would maximise health improvement within a given budget.

Principal component analysis (PCA): PCA is a mathematical technique that is used to create uncorrelated combinations of variables in a dataset – these combinations are known as components. The first component will explain the most variation in the data, followed by the second, and so on. Each component will be a weighted sum of all of the original variables. The weight given to each variable within a component is known as the loading.

Secondary care: a funding stream within the allocations model to CCGs, representing services typically provided in hospital settings subsequent to referral for such services by primary care physicians.

Secondary user service (SUS+): SUS+ is the Secondary Uses Service dataset that contains patient-level data for hospital activity.

Significance: the claim that the effect that the model is attributing to an explanatory variable is genuine; i.e. that the true contribution of that variable is different from zero. It is generally measured by the ***smallness*** of the probability that the variable is ***no*** different from zero; so, a significance near zero (a “p-value” of close to zero) indicates that a variable is playing a genuine role in explaining variation in specialised spending.

Spline: a spline is a type of mathematical function that allows an approximation of a complex function using a combination of simpler functions.

Specialised services: A funding stream representing treatments for complex and/or rare diseases by specialist staff. Sometimes referred to as tertiary care.

Standardisation: A statistical technique that puts different variables on the same scale (e.g. using z-scores), enabling comparisons between areas with different population demographics (e.g. controlling for different proportions of age groups between areas).

Technical Advisory Group (TAG): Supports ACRA with technical expertise regarding allocations and funding recommendations.

T-statistic: a measure of the strength of a signal (in our case the contribution of a variable to explaining variation in the use of specialised services) relative to the statistical noise.

Upstream services: services that address need earlier in the progression of a disease or healthcare condition. In relation to specialised services, this often means intervention before a patient's condition has deteriorated to the point that specialised services are required.