



Overview

Introduction

The Advisory Committee for Resource Allocation (ACRA) plays a key part in the setting resource allocations for integrated care boards (ICBs).

ACRA is an independent, expert, technical committee made up of academics, GPs, NHS managers and public health experts. ACRA's role is to develop evidence-based recommendations on how to estimate the relative need for healthcare resources across different populations, using data on people's characteristics and how those characteristics are associated with future healthcare needs. More detail is outlined in <u>ACRA's terms of reference</u>.

These relative needs are designed to guide resource allocation in a way that supports equal opportunity of access for equal need and contributes to reducing health inequalities that are amenable to healthcare. These aims are confirmed when NHS England commissions ACRA in each allocation round.

Following the 2023/24 allocations round, ACRA were commissioned to recommend any updates to the need estimates for 2025/26 onwards.

As part of the development programme for resource allocations, an update to the primary care prescribing model was prioritised for development.

The primary care prescribing component is part of the ICB core allocations model and covers the costs of medicines prescribed and dispensed in primary care.

The current prescribing model was first implemented for the 2016/17 allocations round, and was a refresh of the model first introduced in 2000. Unlike the majority of other allocations formulae, this model was at GP practice level (not patient level). This same model was used for subsequent allocation rounds.

This publication sets out the development of the prescribing model and describes updates and changes that have been presented to ACRA during the development process. It also sets out the final model as recommended by ACRA. The prescribing model will be used to estimate need for medicines prescribed in primary care in the 2025/26 allocations formula.

ACRA makes its recommendations based on the best available evidence. ACRA undertakes 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 and are provided in Annex A.

ACRA's view is that the updated prescribing model provides an improved estimate of relative need compared to the current model. NHS England has accepted this recommendation and implemented the updated model.

Background to allocations

The principle at the heart of the approach to setting allocations is ensuring equal opportunity of access for equal need.

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 access to services and outcomes.

These 2 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.

Target allocations methodology

The formulae for target allocations estimate the relative need and relative unavoidable costs between ICBs for healthcare services. There are separate formulae for ICBs' core responsibilities, specialised services and primary medical care. For each of these, the relative need is calculated for each GP practice, which is then aggregated to the ICB level. It 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 based on:

- the age and sex distribution of the population (all else being equal, areas with older populations typically have a higher need per head) and additional need over and above that due to age (all else being equal, areas with poorer health have a higher need per head)
- unmet need and health inequalities

- the unavoidably higher costs of delivering health care due to location alone, known as the Market Forces Factor (this reflects that unit staff, land and building input costs are higher in some parts of the country, for example, in London)
- the higher costs of providing emergency ambulance services in sparsely populated areas, an adjustment for the higher costs of unavoidably small hospitals with 24-hour accident and emergency services in remote areas and an adjustment for the unavoidable costs of the private finance initiative (PFI)

As the need for different types of health services varies across the country, there are separate formulae for ICB core responsibilities, specialised services and primary medical care. Within each of these, there are separate components and adjustments – for example the distribution of need for ICB core responsibilities is different for general and acute, mental health, community, maternity and prescribing services.

Each component of the 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 factors to include in the formula to predict future need per head and the relative weight on each of the factors.

Typically, the models estimate need related to age and sex and additional need over and above that due to age and sex as a single set of weights, rather than separately estimating weights for age and additional need. This is because additional need varies by age group. For instance, the health impact of living in a deprived area may be greater for an older person than a younger one.

The statistical models also include "supply" variables to take account of the availability of health care services; where services are more easily available this generally leads to higher use. As utilisation driven by available capacity is not a reflection of need, where the supply variables are included in the models, they are sterilised and set to the national average when calculating relative need. This means areas are not penalised in the formula for lower utilisation due to relatively lower or less accessible capacity.

The previous prescribing model

The prescribing model covers the costs of medicines prescribed and dispensed in primary care.

The model was last refreshed by NHS England for 2016/17 allocations and is based on the cost of prescriptions by GP practice in 2013/14.

This model was not a patient level model: the unit of estimation was GP practice. The model had 2 stages; the first weighted for need related to age and sex using the NHS Digital ASTRO(13)PU - an index of national average costs of prescriptions by age-sex group in 2013. The second stage weighted for need in addition to age and sex.

The model for additional need includes both need and supply variables. The set of variables in the model were determined by statistical goodness of fit and plausibility as indicators of need. The need variables in the final model include:

- Index of Multiple Deprivation (IMD)
- proportion of residents aged over 70 years and over claiming disability living allowance

Development of the new prescribing model

Overview

The development of the prescribing model for 2025/26 allocations represents a fundamental change to the approach to modelling the costs of medicines prescribed in primary care, as it models costs at a patient level for the first time.

The datasets used for the modelling are built using pseudonymised patient data that cannot be attributed to individuals. The data has been pseudonymised and created according to all relevant GDPR principles.

Data used in developing the model

Costing data

Revenue distribution for most services is based on models that best predict the future spend on each individual. Up until now the model for prescribing costs has

been at GP practice level. The availability of a prescription-level data set has enabled the development of an individual level model for prescribing for the first time.

The dependent variable for the prescribing model has been derived from a prescription level dataset that has been provided to NHS England by the NHS Business Services Authority (BSA) and covers prescriptions dispensed in primary care. This has been aggregated to patient level to derive the aggregate cost of prescribed medicines for each individual that had a prescription dispensed in the 2022/23 financial year. Prescriptions where there was no payment have been excluded from the analysis as these are not paid for by ICBs. Reasons for payment not to occur include private prescriptions, items not dispensed and where payment was disallowed. Prescriptions paid for through public health grants and by NHS England for the armed forces families are also excluded.

Costs per head in 2022/23 were calculated for each individual registered with a GP practice in April 2022 by applying the aggregated costs of all medicines prescribed and dispensed in primary care.

Analysis was undertaken to determine if outlying costs should be capped in the creation of the dependent variable. The impact of capping costs at £10k and £100k was considered. Capping at £10k impacted the coefficients of diagnostic variable related to long-term conditions where it would be expected there would be high prescribing costs, and therefore, this option was rejected. There was very little impact of capping at £100k, and investigation of the outliers showed that they represented clinical need. Therefore the decision was made not to cap outliers in the prescribing model.

Explanatory variables

An extensive set of explanatory variables were gathered for testing in the model. The need and supply variables tested in the model are summarised in tables 1 and 2. A full list is in Annex B.

Table 1: Need variables

Explanatory variable	Description
Morbidity flags	Historical diagnosis data were collated for all inpatient episodes and spells in 2018/19 and 2019/20 from the SUS+ dataset for the April 2022 cohort of GP registered patients. SUS+ is the Secondary Uses Service dataset that contains patient-level data for hospital activity.
	of the World Health Organisation defined sub-chapter of the International Classification of Diseases (ICD).
	The use of 2 years of historical diagnosis data is consistent with other allocations models. However previous models have used the 2 years immediately prior to the year for which costs are being modelled. This is not possible for the prescribing model as it has previously been determined by ACRA and TAG that diagnoses from 2020/21 and 2021/22 should not be used due to the impact of Covid. Older historic diagnoses have been used in this model to avoid losing the predictive power of these variables.
Age, sex and area of residence	Age, sex and Lower Super Output Area (LSOA) of residence were taken from the GP registrations data Master Patient Index (MPI).
Ethnicity	Matched each individual's ethnic group using a range of patient level health datasets. This has identified the ethnic group for 61% of individuals. For the remaining population an area-based proportion is used. Ethnicity is now included at ethnic group (16 groups).

Explanatory variable	Description
Household composition	Linking the MPI to the anonymised Unique Property Reference Number (UPRN) allows us to identify all individuals resident in a property and derive a household type variable that indicates the composition of the household as: 8 or more adults, no people aged 16+, 1 adult with children, 1 person household; 2 adults and 1 or more children; 3 to 7 adults with children; 3 to 7 adults aged 20+ with no children, 3 to 7 adults aged under 20, 2 adults of the same gender; 2 adults of different gender; or other.
Household type and tenure	An interaction of household types and tenures.
Outdoor space	Availability of outdoor space for the household.
Variables from the ONS Census of Population	A range of variables relating to population characteristics from the 2021 census. Only available for small geographical areas (lower layer super output areas - LSOAs) rather than for individuals, so individuals are 'attributed' with the value for the LSOA in which they reside.
Coastal and urban or rural flags	Variables indicating whether the LSOA of residence is classified as costal or non-coastal and urban or rural.
Index of Multiple Deprivation (IMD)	The underlying indicators from the Index of Multiple Deprivation. Only available for small geographical areas (lower layer super output areas - LSOAs) rather than for individuals, so individuals are "attributed" with the value for the LSOA in which they reside.
Log population variance	Log of the variance between registered and resident populations for each LSOA. To account for possible list inflation.

Explanatory variable	Description
Variables from the Department of Work and Pensions	Eligibility for Disability Living Allowance (DLA) or Personal Independence Payment (PIP).
Quality Outcomes Framework prevalence data	Prevalence data from the Quality Outcomes Framework (QOF) were also tested as need variables. Individual flags are not available and so individuals are "attributed" with the value for the practice they are registered with.
GP survey	A range of indicators from the GP survey. Individual flags are not available and so individuals are 'attributed' with the value for the practice they are registered with.

Health care use may also be affected by the relative availability of health care services. Variables were tested in the modelling to adjust for this, known as supply variables. While these variables are included in the models as they affect utilisation, they are not included in the formula to calculate weighted populations; instead their value for each area was set to the national average (sterilised). This means if an area has lower use of health care services because of lower capacity or longer distance, this is corrected for in the formula.

Explanatory variable	Description
ICB dummy	A flag for each individual indicating which ICB is responsible for commissioning their health care – based on the GP practice at which they are registered.
Quality Outcomes Framework scores and exception rates	Weighted achievement score and vaccination and immunisation rates from the Quality Outcomes Framework (QOF) were also tested as supply variables. Individual flags are not available and so individuals are "attributed" with the value for the practice they are registered with.
GP workforce survey	A range of variables relating to GP workforce. Individual flags are not available and so individuals are "attributed" with the value for the practice they are registered with.
Distance to GP practice	Gravity weighted distance to GP practice

Table 2: Supply variables

Due to the high number of attributed need variables, rationalisation of the variables tested in the model was undertaken by splitting the variables into thematic groups and using principal components analysis (PCA) to identify the most important variables. The large number of attributed need variables available to the model requires a large degree of variable selection that is mostly statistically driven through test statistics of coefficients. Preliminary selection using principal components was

used to reduce data and the necessary computational power required in this final variable selection.

The attributed variables were split into thematic groups. For each group of variables all possible components were created and variables were kept which on their own captured at least 5% of the variance each or cumulatively captured at least 90% of the variance, whichever condition was met first. For groups that contained more than 10 variables, the 3 most important variables from the first principal component were selected, 2 variables from the second and 1 variable from each subsequent component. For groups of 10 or fewer variables, the 2 most important variables were selected from the first principal component and 1 variable from each subsequent component. If any suggested-to-be-selected variable had already been selected in a previous component we moved on to select the next most important variable of the current component.

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 is not undertaken and all variables of that group are included as candidate variables in the final model. 10 groups of variables were created:

- QOF prevalence
- QOF scores
- QOF exception rates
- GP immunisation rates
- hospital supply variables
- barriers (subset of IMD variables)
- education (subset of IMD and census variables)
- health (subset of IMD and census variables)
- income (subset of IMD and census variables)
- living environment (subset of IMD variables)

Of the 10 groups, only living environment could not be reduced through PCA. The full set of variables used in the modelling, following this PCA process are listed in Annex B.

Model specification

Age functional form

Following the change made in the 2022/23 general and acute model, age and gender are included in the prescribing model using linear splines with 18 knots. The use of splines allows the impact of age on predicted costs to vary within age groups.

Number of diagnostic positions

During the development of the general and acute model for 2022/23 allocations, analysis was undertaken to determine the optimal number of diagnostic positions to use in the creation of the diagnostic flags. In the updated dataset, the number of secondary diagnostic positions that can be recorded was increased from 13 to 23. Following this analysis the number of secondary diagnostic positions was changed from 6 to 12.

The diagnostic flags for the prescribing model are created based on the primary diagnosis and 12 secondary diagnosis in line with the general acute model.

Interactions of age-gender with household type and ethnicity

Following testing in the model, 2 interactions were included in the prescribing model. Household type and ethnicity were each interacted with age to allow for heterogenous effects of household type and ethnicity across the age distribution.

Figure 1 shows the age cost curve by household type for actual costs. This indicates that there are differences in costs for different household types for different ages. Of particular note are the higher costs for those aged over 50 in households of more than 8 adults (although there is a reduction in average costs for the very oldest age groups in this household type), many of which are likely to be care homes. This is reflected in the age spline coefficients for this household type. At younger ages, the majority of households have higher average costs than the reference group (households with 2 adults with children).

Figure 1: Age cost curve for household types (average costs per head)



Figure 2 below shows that there are different relationships between age and ethnicity for actual prescribing costs which could be better accounted for by including an interaction in the model. In early adulthood there is little difference in average costs between different ethnic groups. The differences between groups are greater at younger and older ages.

For the very young, the average costs are higher for most ethnic groups compared to the White British reference group. Both Bangladeshi and Pakistani ethnic groups have significantly higher costs from age 50 to age 85. The Chinese and any other ethnic groups have lower average costs than White British at all ages.

Figure 2: Age cost curve by ethnic group (average costs per head)



Final model selection

The final model specification ACRA has now recommended for the prescribing model is shown in table 3.

Table 3: Prescribing model specification

Model component								
Age linear splines interacted with gender								
Morbidity flags								
Household type								
Property type and tenure								

ICB dummies Ethnicity Interaction of age and household type Interaction of age and ethnicity Attributed need and supply variables

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. The quantified relationships found were taken to be predictors of relative future, cost-weighted need for health care services, with the exception of the supply variables.

Consistent with previous person-based resource allocation modelling approaches, 3 random samples were used to estimate and validate the models:

- an estimation sample (S1) was used to develop the model and to conduct statistical analysis. This was a 15% randomly selected sample of 9,243,775 individuals from 6509 GP practices
- a validation sample (S2) was used to validate the performance of the model at the individual level. Like sample S1, it is a random sample of 15% of 9,244,712 individuals from 6506 GP practices. Samples S1 and S2 were mutually exclusive, so no individual was in both samples
- a validation sample (S3) was also used to validate the performance of the models. S3 was all those registered with a randomly selected sample of 15% of GP practices with 1,000 or more patients. This sample had 8,910,542 individuals from 926 GP practices

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 costs of prescribed drugs and other items prescribed in primary care. A stepwise approach as described below is used to select variables for the final model. Variable selection is undertaken on the estimation sample, S1. The final coefficients for the selected variables are then calculated using the whole dataset. In line with previous recommendations, some groups of variables are considered together and if any are significant, the whole group are retained in the model. For the prescribing model this is true for age, gender, ethnicity, household type, age and household type interactions, age and ethnicity interactions, historic diagnoses and ICB dummies.

The variable selection approach involves a "fixed" component, and variable selection component. The fixed component includes age, ethnicity, morbidity (diagnostic groups) and ICB dummy variables that do not enter the variable selection process but are included in the model irrespective of significance. The selection component includes all other candidate variables as set out in Annex B.

The selection component involves fitting all candidate variables into an OLS model and then removing variables using a t test to calculate how significant each variable is in the model. Variables are removed at a certain level of t beginning at t= 0.2, then refitting the model and subsequently removing variables at increasing levels of t until t= 2.58 (significant at 99% level).

Morbidity (previous diagnoses) and age were the most important variables in the model. The final model explains 88% of variation in costs at the GP practice level. This is compares to 89% for the general and acute model. The coefficients for the variables selected for the model are at Annex C.

The variation in modelled costs per head by age and sex are in figure 3. Average costs are higher for women in younger adulthood to middle age and higher for men in older age groups. This is consistent with the age cost curves for general and acute hospital services.

Figure 3: Age cost curve for prescribing costs



Impact of final model

Calculation of need indices

Once the variables in the model had been determined, weighted populations were produced for GP practices, which were summed to ICBs to reflect relative need for healthcare in each area. As part of this process the supply variables are "sterilised".

Previous recommendations have been that the effect of ethnicity should not be to reduce allocation of resources where the coefficients from the models indicate lower need. In the absence of other evidence, this is assumed to reflect unmet need. In previous models with main effects only for ethnicity, negative coefficients have been set to 0 prior to model predictions to achieve this objective. In this model, with the additional complexity of an age and ethnicity interaction, a slightly different approach has been taken. This has the same effect of ensuring that at any age group, the net effect of the ethnic group characteristic in the model is not less than for White British. The health inequalities adjustment, which is applied separately, targets additional underlying need.

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

To allow comparison of the new model to the previous model, the need indices have been calculated for the existing model and the proposed model using the same 2022/23 populations so that any changes observed were due to the update of the model and not due to population shifts.

Impact by age and deprivation

The need indices for age and IMD quintiles are shown in tables 4 to 6. These quintiles were derived by assigning each GP practice to an age (proportion aged over 65 years) and deprivation (IMD score) quintile based on the characteristics of their registered population. In this way it was possible to examine how need indices vary by age and deprivation for different models. Tables 4 and 5 show that both models have the expected pattern of higher need for areas with older more deprived populations and a lower level of need in areas with younger less deprived populations.

Shifting to a patient level model for prescribing where the dependent variable is at patient level and where a range of patient level variables, such as age, gender and diagnoses can be included, led to an increase in predicted relative need for older populations and a decrease for younger populations as shown in table 6.

		Age quintile (A1 = youngest quintile, A5												
			= oldest quintile)											
		A1	A1 A2 A3 A4 A5											
Deprivation	D1	0.62	0.80	0.89	0.97	1.09	0.95							
quintile	D2	0.61	0.85	0.95	1.04	1.18	0.99							
(D1 = least	D3	0.69	0.90	1.02	1.12	1.26	0.99							
D5 = most	D4	0.78	0.98	1.09	1.19	1.32	1.00							
deprived)	D5	0.91	1.11	1.20	1.28	1.56	1.09							
		0.77	0.95	1.02	1.08	1.18								

Table 4: GP practice need indices for previous model by age and IMD quintile

Table 5: GP practice need indices for new model by age and IMD quintile

		Age qu	Age quintile (A1 = youngest quintile, A5 = oldest quintile)							
		A1	A2	A3	A4	A5				
Deprivation	D1	0.56	0.77	0.89	0.99	1.11	0.96			
quintile	D2	0.58	0.85	0.97	1.07	1.19	1.00			
(D1 = least	D3	0.63	0.91	1.04	1.15	1.26	0.99			
D5 = most	D4	0.74	0.97	1.11	1.22	1.32	1.00			
deprived)	D5	0.86	1.09	1.20	1.29	1.51	1.07			
		0.72	0.94	1.03	1.10	1.19				

Table 6: Change in weighted population between previous and new model byage and IMD quintile

		Age qu	Age quintile (A1 = youngest quintile, A5 = oldest quintile)							
		A1								
Deprivation	D1	-0.05	-0.03	0.00	0.02	0.02	0.01			
quintile	D2	-0.04	0.00	0.02	0.03	0.01	0.01			
(D1 = least	D3	-0.06	0.00	0.02	0.03	0.01	0.00			
D5 = most	D4	-0.04	-0.01	0.02	0.03	0.01	0.00			
deprived)	D5	-0.05	-0.02	0.00	0.00	-0.05	-0.02			
		-0.05	-0.01	0.01	0.03	0.01				

Geographical impact

Local authority cartograms showing the prescribing need indices for the new model and the change in need indices between the 2 models are shown in figures 3 and 4 below. Figure 3 shows that need indices are higher in areas with older populations. Figure 4 shows that need indices have reduced for areas with younger populations.

nev	v pr	escr	ribin	g m	ode	l ne	ed i	nde	X								L	AD	21-IC	CB23	3 cai	togra	am v	/1.2
А														0.96	1.29				16					5
В			F	Regio	n						1.21	1.15	1.19	1.27	1.19				1.0					
С				ICB							1.28	1.13	1.19	1.10	1.26				1.4					
D				LAD)					1.27	1.15	1.15	1.05	1.28	1.27				1.2					
Е									1.19	1.05	1.11	1.03	1.13	1.17	1.26				1					
F								1.32	1.05	1.10	1.19	1.03	0.92	1.13	1.01				8.0					
G						1.28	1.09	1.11	1.22	1.13	1.05	0.87	1.00	1.17	1.13	1.11			0.6					
Н						1.30	1.11	1.03	1.09	1.07	1.01	1.11	1.20	1.17	1.11	1.16			0.4					
						1.15	1.27	1.17	0.97	1.04	1.13	1.11	1.01	1.17	1.14	0.91	1.40		0.2					
J						1.25	1.23	0.97	0.87	1.06	1.13	1.29	1.27	1.11	1.19	1.10	1.00		0					
Κ						1.06	1.27	1.24	1.11	1.16	0.97	1.23	1.21	0.9	1.0	1.08	1.11					_		
L							1.09	1.08	1.15	1.21	1.02	1.10	1.10	0.94	1.08	1.03	0.89	1.14	1.25	0.92	1.37			
Μ							1.18	1.07	1.16	1.11	1.01	1.03	1.03	0.86	1.06	0.94	0.98	0.96	1.13	1.17	1.23			
Ν								1.20	1.14	1.15	1.10	0.97	1.02	0.99	0.98	0.96	0.90	0.60	1.06	1.23				
0								1.16	1.03	1.01	1.09	1.06	1.07	88.0	0.90	0.97	1.03	0.93	1.09	0.94	0.98			
Ρ								1.16	1.04	1.09	0.95	0.84	0.92	0.98	0.95	0.83	0.97	0.88	1.10	1.16	1.36			
Q								0.97	1.12	1.09	1.05	1.07	0.95	0.85	0.94	0.92	0.98	1.00	1.03	0.91	1.10	1.07		
R								1.15	1.04	1.00	1.01	0.92	0.93	0.90	0.80	0.83	0.86	0.84	0.92	0.99	1.12	1.03		
S							1.00	0.99	0.91	0.94	0.94	0.68	0.85	0.83	0.60	0.72	0.79	0.78	0.81	0.82	0.88	1.18		
Т							0.85	1.03	1.05	1.06	0.89	0.90	0.82	0.80	0.79	0.68	0.78	0.78	0.73	0.76	0.95	1.06		
U							1.13	1.16	1.06	0.91	0.73	0.79	0.86	0.77	0.66	0.85	0.72	0.84	0.95	0.92	0.94	0.98		
V						1.23	1.15	1.18	1.17	1.02	0.94	0.92	0.83	0.95	0.76	0.77	0.82	0.79	0.92	0.96	0.98	0.98		
W				1.21	0.86	1.13	1.06	1.23	1.03	1.22	0.95	1.05	0.94	0.92	0.80	0.93	88.0	0.94	1.00	0.95	0.99	1.16		
Х			1.20	1.13	1.15	1.24	1.20			1.08	0.90	1.00	0.93	0.86	0.84	0.99	1.02	0.94	1.12	1.37	0.98	1.20		
Y											1.17	0.93	1.20	1.12	1.22	1.11	1.00	0.94	1.21	1.23				
Ζ		0.99								1.31						1.13	0.80	1.14						
	а	b	С	d	е	f	q	h	i	i	k		m	n	0	р	q	r	s	t	u	V	W	Х

Figure 3: Local authorities need indices for the new prescribing model

Figure 4: Difference in local authority need indices between current model and new model

cha	nge	in p	res	cribi	ng r	need	l ind	ex									L	AD2	21-10	CB23	3 car	togra	am v	/1.2
А														0.02	0.09									5
В			R	Regio	n						-0.02	0.00	0.05	0.04	0.08			(J.15					
С				ICB							0.05	-0.01	0.02	-0.02	0.08				0.1					
D				LAD)					0.06	0.06	0.07	-0.08	0.06	0.04				0.05					
Е									0.03	0.01	0.04	-0.01	0.06	0.05	0.02			(J.05					
F								0.10	0.04	0.07	0.04	0.05	0.01	-0.02	-0.12				0					
G						-0.01	0.11	0.07	0.06	0.04	-0.02	-0.10	0.00	-0.02	0.02	-0.04) OF					
Н						0.09	0.07	-0.03	0.00	0.04	0.00	0.00	0.02	0.00	-0.03	0.02		-(J.U5					
						0.01	0.05	0.03	-0.04	0.02	0.02	0.05	0.00	0.05	-0.02	-0.05	-0.01		-0.1					
J						0.03	-0.03	0.02	-0.06	0.03	0.01	0.11	0.08	0.08	0.08	0.07	-0.05		15					
Κ						-0.08	0.08	0.06	0.06	0.01	-0.03	0.09	0.10	0.0	0.0	0.03	0.00	-(5.15					
L							0.04	0.05	0.01	0.05	0.03	0.03	0.07	0.01	0.02	0.03	-0.07	0.00	0.03	-0.06	-0.01			
M							0.04	0.02	0.08	0.09	0.00	0.01	0.01	-0.05	-0.02	-0.01	0.03	0.00	0.02	0.01	0.02			
Ν								-0.01	0.06	0.07	0.05	0.02	0.04	0.00	0.04	0.04	0.00	-0.09	0.00	0.01				
0								-0.05	0.00	-0.06	0.08	0.00	0.00	0.00	0.03	0.06	0.06	-0.02	0.04	0.01	-0.03			
Ρ								-0.02	0.01	-0.01	0.00	-0.07	-0.01	0.06	0.03	-0.01	0.01	0.00	0.02	0.01	-0.03			
Q								-0.03	0.00	0.00	0.06	0.01	0.02	0.02	0.04	0.05	-0.03	0.03	0.00	-0.02	-0.01	0.05		
R								0.00	0.00	-0.08	0.01	0.01	0.03	0.10	0.00	-0.01	-0.06	-0.03	-0.03	0.03	0.02	-0.03		
S							0.08	0.00	-0.03	0.00	0.01	-0.01	0.01	-0.01	-0.12	-0.02	-0.07	-0.04	-0.02	-0.08	-0.01	-0.07		
Т							-0.02	-0.02	-0.03	0.02	-0.04	-0.03	0.09	-0.03	-0.09	-0.10	-0.04	0.00	-0.02	-0.03	-0.02	0.00		
U							0.08	0.03	-0.02	-0.01	-0.06	-0.04	0.02	-0.08	-0.05	-0.03	-0.08	-0.04	0.02	-0.03	-0.02	0.07		
V						-0.05	-0.05	0.02	0.03	0.03	0.07	0.03	-0.02	0.00	-0.01	-0.03	-0.04	-0.07	0.01	-0.02	0.04	0.00		
W				-0.02	-0.01	-0.05	-0.07	0.02	-0.01	0.05	-0.01	0.05	0.04	0.00	-0.08	0.05	0.01	0.05	0.08	0.02	0.01	0.01		
Х			-0.01	0.06	-0.06	-0.05	-0.03			0.04	0.00	0.07	0.03	0.00	0.00	0.03	0.04	0.10	0.03	0.07	0.01	0.03		
Y											0.07	-0.04	0.06	-0.01	0.02	0.02	0.01	0.01	0.06	0.04				
Ζ		-0.02								0.00						0.00	-0.09	0.01						
	а	b	С	d	е	f	g	h	i	j	k		m	n	0	р	q	r	S	t	u	V	W	Х

Annex A: ACRA's criteria for assessing formulae

Criteria	Definition
Transparency and simplicity	The construction and application of the formula should aim for simplicity, be well documented and be open to scrutiny.
Comprehensibility	The formula and its derivation should be explainable to non-specialists in plain English and be capable of common sense justification, even if the detail is understood only by specialists.
Evidence base	The formulae are based on the best evidence available.
Technical robustness	The techniques used must be consistent with best practice methods for statistical and econometric modelling and be applied appropriately.
Objectivity	Formula should be based on plausible relationships and there should be tests of bias, robustness, statistical significance and explanatory power.
Flexibility	The recommendations can respond to changes of commissioning responsibilities (for example, coverage of services) and size.
Parsimony	The formula should not include relationships of low materiality. All other things being equal fewer rather than more variables are preferred.
Plausibility	The measures and relationships in the formula should be plausible and have face validity.
Clarity of contribution of indicators	The contribution made by individual components in the formula should avoid ambiguity. Where multiple indicators are used the purpose, weighting and selection must be clear.
Reliability of data	The data are available and consistent for all local areas (units of allocation) where possible and not subject to local variations in reporting.
Freedom from perverse incentives	The methods and data sources used to calculate the formula should not create perverse incentives either for manipulating data or other negative behaviours.
Durability and stability	The relationships used to drive the formula should be durable and the data used to derive the formula should be stable.
Updateable	The scale of the work required to update the formula is manageable within the time constraints of the allocation cycle.

Annex B: Variables tested in the model

Individual variables

Age and gender splines						
Age <1	Age 40-44					
Age 1-4	Age 45-49					
Age 5-9	Age 50-54					
Age 10-14	Age 55-59					
Age 15-19	Age 60-64					
Age 20-24	Age 65-69					
Age 25-29	Age 70-74					
Age 30-34	Age 75-79					
Age 35-39	Age 80-84					
Age 40-44	Age 85+					
Household type	•					
Household with 8 or more adults	Household with 3-7 adults aged 20+ without children					
Household with no people aged 16+	Household with 3-7 adults aged under 20 without children					
Household with 1 adult and children	Household with 2 adults of different gender					
1 person household	Household with 2 adults of same gender					
Other household type	Unknown household type					
Household with 3-7 adults and children						
Age and household type interactions						
Ethnic 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	
Age and ethnicity interactions	
Private outdoor space	
Property and tenure type	
Detached and owner occupied	Terraced and owner occupied
Detached and private rented	Terraced and private rented
Detached and social rented	Terraced and social rented
Detached and unknown tenure	Terraced and unknown tenure
Semi-detached and owner occupied	Flat and owner occupied
Semie-detached and private rented	Flat and private rented
Semi-detached and social rented	Flat and social rented
Semi-detached and unknown tenure	Flat and unknown tenure
Other property type	
Educational establishment	Medical establishment
Temporary accommodation	Commercial establishment
Sheltered accommodation	Other
Military establishment	Unknown

Diagnoses – included as individual diagnostic flags

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 and 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 and viral haemorrhagic fevers	L40-L45 Papulosquamous disorders (including Psoriasis)
B00-B09 Viral infections characterized by skin and mucous membrane lesions	L50-L54 Urticaria and erythema
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 and connective tissue
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 and intrathoracic organs	N25-N29 Other disorders of kidney and 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 and other parts of central nervous system	O10-O75, O85-O92, O94-O99 Complications of labour and delivery
C73-C80, C97 Malignant neoplasm of thyroid and other endocrine glands	O80-O84 Delivery
C81-C96 Malignant neoplasms of lymphoid, haematopoietic and related tissue	P00-P04 Complications of foetus/neonate affected by maternal
D00-D48 In situ and 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 and signs involving the circulatory/respiratory system
E10-E14 Diabetes Mellitus	R10-R19 Symptoms and signs involving the digestive system and abdomen
E15-E90 Endocrine nutritional and metabolic diseases	R20-R23 Symptoms and signs involving the skin and subcutaneous tissue
F00-F03 Dementia	R25-R29 Symptoms and signs involving the nervous and musculoskeletal sys.

F04-F09 Other organic including symptomatic mental disorders	R30-R39 Symptoms and signs involving the urinary system
F10-F19 Mental and behavioural disorders due to psychoactive substances	R40-R46 Symptoms and signs involving cognition, perception, emotional state and behaviour
F20-F29 Schizophrenia, schizotypal and delusional disorders	R47-R49 Symptoms and signs involving speech and voice
F30-F39 Mood [affective] disorders	R50-R68 General symptoms and signs
F40-F69 Neurotic, behavioural and personality disorders	R69 Unknown and unspecified causes of morbidity
F70-F79 Mental retardation	R70-R89 Abnormal findings of bodily fluids or samples without diagnosis
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 III-defined and unknown causes of mortality
G10-G14, G30-G32 Other degenerative diseases (including Alzheimer's)	S00-S09 Injuries to the head
G20-G26 Extrapyramidal and movement disorders (including Parkinsonism)	S10-S19 Injuries to the neck
G35-G37 Demyelinating diseases (including Multiple Sclerosis) of the central nervous system	S20-S29 Injuries to the thorax
G40-G47 Epilepsy, migraine and other episodic disorders	S30-S39 Injuries to abdomen, lower back, lumbar spine and pelvis
G50-G73 G90-G99 Other diseases and disorders of the nervous system	S40-S49 Injuries to the shoulder and upper arm
G80-G83 Cerebral palsy and other paralytic syndromes	S50-S59 Injuries to the elbow and forearm
H00-H06, H15-H22, H30-H36, H43-H59 Other disorders of the eye	S60-S69 Injuries to the wrist and hand

H10-H13 Disorders of conjunctiva (including conjunctivitis)	S70-S79 Injuries to the hip and thigh
H25-H28 Disorders of lens (including cataracts)	S80-S89 Injuries to the knee and lower leg
H40-H42 Glaucoma	S90-S99 Injuries to the ankle and foot
H60-H95 Diseases of the ear and mastoid process	T00-T07 Injuries involving multiple body regions
100-109 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 and diseases of pulmonary circulation	T33-T35 Frostbite
130-152 Other forms of heart disease	T36-T50 Poisonings by drugs medicaments and biological substances
160-169 Cerebrovascular diseases	T51-T65 Toxic effects of substances chiefly non-medicinal as to source
I70-I79 Diseases of arteries, arterioles and capillaries	T66-T78 Other and unspecified effects of external causes
180-189 Diseases of veins and lymphatic system not elsewhere classified	T79 Certain early complications of trauma
I95-I99 Other and unspecified disorders of the circulatory system	T80-T88 Complications of surgical and medical care not elsewhere classified
J00-J06 Acute upper respiratory infections	T90-T98 Sequelae of injuries of poisoning and other consequences
J09-J18 Influenza and 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 and jaws	Z30-Z39 Health services in circumstances related to reproduction
K20-K31 Diseases of oesophagus, stomach and duodenum	Z40-Z54 Persons encountering health services for specific care
K35-K38 Diseases of appendix	Z55-Z65 Potential health hazards related to socioeconomic and psychosocial circumstances
K40-K46 Hernia	Z70-Z76 Persons encountering health services in other circumstances
K50-K52 Noninfective enteritis and colitis	Z80-Z99 Persons with potential health hazards related to family
K55-K64 Other diseases of intestines	U Unclassified

LSOA attributed variables

Variable	Source
% DLA/PIP	DWP
Log population variance	NHS E/ONS
Coastal flag	CMO report
Rural/urban flags	ONS
Crime score	IMD
Income score**	IMD
Employment score**	IMD
% never worked or unemployed**	2021 Census
Disabled persons (age standardised rate per 100,000)**	2021 Census
Disabled people in poor health (age standardised per 100,000)**	2021 Census
Years of potential life lost indicator**	IMD
Mood and anxiety disorders indicator**	IMD
% aged 16-74 with no qualifications (age standardised)**	2021 Census
Entry to higher education indicator**	IMD
Adult skills and English language proficiency indicator**	IMD
Road distance to a post office indicator (km)**	IMD
Road distance to general store or supermarket indicator (km)**	IMD
Homelessness indicator**	IMD
Housing affordability indicator**	IMD
Housing in poor condition indicator	IMD
Houses without central heating indicator	IMD
Air quality indicator	IMD
Road traffic accidents indicator	IMD
% single (never married)	2021 Census
% widowed divorced or separated (marriage or civil partnership)	2021 Census

% single pensioner households	2021 Census
% students in population	2021 Census
% unpaid carers	2021 Census

** variable from PCA

GP practice attributed variables

Variable	Source
% with GP appointment in last 3 months	GP patient survey
% with long term condition	GP patient survey
% with a long term condition that impacts on day to day activities a lot	GP patient survey
Average number of long term medical conditions for those with at least 1	GP patient survey
Coronary heart disease prevalence**	QOF
Hypertension prevalence**	QOF
Stroke and transient ischaemic attack prevalence**	QOF
Learning disability prevalence**	QOF
Mental health prevalence**	QOF
Palliative care prevalence**	QOF
** variable from PCA	

Supply variables

Variable	Source
ICB dummy variables	
Road distance to a GP surgery indicator (km)**	IMD
Patients per GP FTE	GP workforce survey
Patients per nurse FTE	GP workforce survey

Patient per direct patient care FTE	GP workforce survey
% points achieved for overall achievement score	QOF
% with Diptheria, tetanus and pertussis by 8 months	QOF
% with MMR by 18 months	QOF
% with MMR and DTa/IPV by 5 years	QOF
% 80 year olds with shingles vaccine	QOF

ICB Dummy variables

NHS Lancashire and South Cumbria ICB
NHS South Yorkshire ICB
NHS Herefordshire and Worcestershire ICB
NHS Mid and South Essex ICB
NHS Bedfordshire, Luton and Milton Keynes ICB
NHS Birmingham and Solihull ICB
NHS North East and North Cumbria ICB
NHS Derby and Derbyshire ICB
NHS Suffolk and North East Essex ICB
NHS Devon ICB
NHS Lincolnshire ICB
NHS Leicester, Leicestershire and Rutland ICB
NHS South East London ICB
NHS Kent and Medway ICB
NHS Hertfordshire and West Essex ICB
NHS North East London ICB
NHS North Central London ICB
NHS Norfolk and Waveney ICB
NHS Staffordshire and Stoke-on-Trent ICB
NHS Frimley ICB
NHS Sussex ICB
NHS Shropshire, Telford and Wrekin ICB
NHS Greater Manchester ICB
NHS Humber and North Yorkshire ICB
NHS Bath and North East Somerset, Swindon and Wiltshire ICB

NHS Northamptonshire ICB
NHS Gloucestershire ICB
NHS Hampshire and Isle Of Wight ICB
NHS North West London ICB
NHS Somerset ICB
NHS Cornwall and The Isles Of Scilly ICB
NHS Buckinghamshire, Oxfordshire and Berkshire West ICB
NHS Black Country ICB
NHS Cambridgeshire and Peterborough ICB
NHS Bristol, North Somerset and South Gloucestershire ICB
NHS Dorset ICB
NHS South West London ICB
NHS West Yorkshire ICB
NHS Coventry and Warwickshire ICB
NHS Surrey Heartlands ICB
NHS Cheshire and Merseyside ICB
NHS Nottingham and Nottinghamshire ICB

Annex D: Coefficients for the prescribing model

Variable	Coefficient	Significance
Constant	117.67	0

Age and gender

Variable	Coefficient	Significance
Male	18.57	0
Age <1	-75.48	0
Age 1-4	-6.55	0
Age 5-9	4.43	0
Age 10-14	1.67	0
Age 15-19	-6.58	0
Age 20-24	1.57	0
Age 25-29	4.07	0
Age 30-34	2.96	0
Age 35-39	2.90	0
Age 40-44	4.81	0
Age 45-49	6.05	0
Age 50-54	2.04	0
Age 55-59	3.11	0
Age 60-64	8.00	0
Age 65-69	3.98	0
Age 70-74	6.35	0
Age 75-79	5.98	0.004
Age 80-84	7.92	0.004

Age 85+	-12.83	0
Male: Age <1	-16.50	0
Male: Age 1-4	-1.27	0
Male: Age 5-9	2.83	0
Male: Age 10-14	-1.56	0
Male: Age 15-19	-2.33	0
Male: Age 20-24	-0.54	0.011
Male: Age 25-29	-1.15	0
Male: Age 30-34	-1.21	0
Male: Age 35-39	-0.32	0.101
Male: Age 40-44	-1.40	0
Male: Age 45-49	-2.24	0
Male: Age 50-54	2.49	0
Male: Age 55-59	4.98	0
Male: Age 60-64	4.65	0
Male: Age 65-69	4.67	0
Male: Age 70-74	2.39	0
Male: Age 75-79	0.15	0.603
Male: Age 80-84	-0.56	0.086
Male: Age 85+	-2.58	0

Household type main effects (reference group – 2 adults with children)

Variable	Coefficient	Significance
8 or more adults	-23.32	0
No people age 16+ in household	-22.76	0
1 adult with children	-3.60	0.043
1 person household	3.83	0.552

Other	7.84	0.914
3-7 adults with children	-5.54	0.001
3-7 adults aged 20+ with no children	-1.33	0.47
3-7 adults aged under 20	9.37	0.002
2 adults - different gender	-15.22	0.004
2 adults - same gender	-15.37	0.003
Unknown	15.23	0.002

Household type and age interactions

Variable	Coefficient	Significance
Age<1		
8 or more adults	17.06	0.004
No people age 16+ in household	17.45	0.01
1 adult with children	-5.88	0.008
1 person household		
Other	-34.48	0.696
3-7 adults with children	7.23	0
3-7 adults aged 20+ with no children		
3-7 adults aged under 20		
2 adults - different gender		
2 adults - same gender		
Unknown	-3.07	0.619
Age 1-4		
8 or more adults	-0.07	0.956
No people age 16+ in household	-2.30	0.097
1 adult with children	-1.59	0.001
1 person household		

Other	2.95	0.854
3-7 adults with children	-0.92	0.027
3-7 adults aged 20+ with no children		
3-7 adults aged under 20		
2 adults - different gender		
2 adults - same gender		
Unknown	0.33	0.817
Age 5-9		
8 or more adults	-1.42	0.116
No people age 16+ in household	0.52	0.598
1 adult with children	0.87	0.006
1 person household		
Other	0.83	0.914
3-7 adults with children	-0.69	0.01
3-7 adults aged 20+ with no children		
3-7 adults aged under 20		
2 adults - different gender		
2 adults - same gender		
Unknown	-0.45	0.65
Age 10-14		
8 or more adults	-0.28	0.71
No people age 16+ in household	0.39	0.745
1 adult with children	0.08	0.82
1 person household		
Other	15.20	0.007
3-7 adults with children	0.41	0.104
3-7 adults aged 20+ with no children		

3-7 adults aged under 20		
2 adults - different gender		
2 adults - same gender		
Unknown	3.06	0.001
Age 15-19		
8 or more adults	7.88	0
No people age 16+ in household		
1 adult with children	-1.29	0.116
1 person household	2.34	0.115
Other	-59.79	0.001
3-7 adults with children	4.62	0
3-7 adults aged 20+ with no children	6.90	0
3-7 adults aged under 20	2.99	0
2 adults - different gender	7.51	0
2 adults - same gender	7.90	0
Unknown	1.44	0.082
Age 20-24		
8 or more adults	-1.83	0.001
No people age 16+ in household		
1 adult with children	0.79	0.406
1 person household	2.12	0.001
Other		
3-7 adults with children	-1.63	0.001
3-7 adults aged 20+ with no children	-0.58	0.224
3-7 adults aged under 20	-0.41	0.502
2 adults - different gender	0.28	0.661
2 adults - same gender	0.05	0.948

Unknown	-2.17	0.002
Age 25-29		
8 or more adults	-1.72	0.001
No people age 16+ in household		
1 adult with children	0.61	0.311
1 person household	-1.85	0
Other		
3-7 adults with children	-2.17	0
3-7 adults aged 20+ with no children	-2.56	0
3-7 adults aged under 20	-2.87	0
2 adults - different gender	-1.85	0
2 adults - same gender	-1.57	0.005
Unknown	-1.82	0.005
Age 30-34		
8 or more adults	-0.50	0.301
No people age 16+ in household		
1 adult with children	0.69	0.136
1 person household	1.53	0
Other		
3-7 adults with children	-0.73	0.021
3-7 adults aged 20+ with no children	-0.30	0.343
3-7 adults aged under 20	-1.47	0
2 adults - different gender	0.20	0.568
2 adults - same gender	-0.39	0.452
Unknown	-0.35	0.591
Age 35-39		
8 or more adults	1.19	0.023

No people age 16+ in household		
1 adult with children	1.50	0.001
1 person household	2.36	0
Other		
3-7 adults with children	0.21	0.457
3-7 adults aged 20+ with no children	1.40	0
3-7 adults aged under 20	0.21	0.649
2 adults - different gender	1.61	0
2 adults - same gender	2.47	0
Unknown	2.25	0.002
Age 40-44		
8 or more adults	1.48	0.013
No people age 16+ in household		
1 adult with children	1.05	0.052
1 person household	2.73	0
Other		
3-7 adults with children	0.41	0.135
3-7 adults aged 20+ with no children	-0.26	0.431
3-7 adults aged under 20	0.97	0.067
2 adults - different gender	1.60	0
2 adults - same gender	0.60	0.294
Unknown	1.74	0.028
Age 45-49		
8 or more adults	3.43	0
No people age 16+ in household		
1 adult with children	1.56	0.021
1 person household	3.13	0

Other		
3-7 adults with children	0.17	0.578
3-7 adults aged 20+ with no children	-0.40	0.222
3-7 adults aged under 20	0.58	0.324
2 adults - different gender	1.19	0.001
2 adults - same gender	2.10	0
Unknown	4.53	0
Age 50-54		
8 or more adults	5.18	0
No people age 16+ in household		
1 adult with children	-0.96	0.324
1 person household	-0.50	0.253
Other		
3-7 adults with children	0.11	0.794
3-7 adults aged 20+ with no children	-1.48	0
3-7 adults aged under 20	0.46	0.477
2 adults - different gender	-1.71	0
2 adults - same gender	-0.71	0.225
Unknown	0.74	0.41
Age 55-59		
8 or more adults	5.41	0
No people age 16+ in household		
1 adult with children	4.45	0.004
1 person household	-1.64	0.005
Other		
3-7 adults with children	-0.41	0.507
3-7 adults aged 20+ with no children	-1.85	0.001

3-7 adults aged under 20	-1.88	0.022
2 adults - different gender	-2.24	0
2 adults - same gender	-1.86	0.01
Unknown	1.29	0.2
Age 60-64		
8 or more adults	6.37	0
No people age 16+ in household		
1 adult with children	0.77	0.744
1 person household	-3.15	0
Other		
3-7 adults with children	-1.20	0.183
3-7 adults aged 20+ with no children	0.07	0.932
3-7 adults aged under 20	-2.54	0.021
2 adults - different gender	-2.12	0.01
2 adults - same gender	-2.28	0.021
Unknown	-0.23	0.85
Age 65-69		
8 or more adults	18.90	0
No people age 16+ in household		
1 adult with children	-9.39	0.003
1 person household	-2.30	0.047
Other		
3-7 adults with children	-1.07	0.385
3-7 adults aged 20+ with no children	2.49	0.031
3-7 adults aged under 20	2.06	0.156
2 adults - different gender	1.05	0.356
2 adults - same gender	1.58	0.228

Unknown	5.60	0
Age 70-74		
8 or more adults	9.14	0
No people age 16+ in household		
1 adult with children	1.95	0.626
1 person household	-1.08	0.466
Other		
3-7 adults with children	1.91	0.228
3-7 adults aged 20+ with no children	1.19	0.426
3-7 adults aged under 20	1.82	0.325
2 adults - different gender	1.30	0.379
2 adults - same gender	0.18	0.913
Unknown	0.30	0.87
Age 75-79		
8 or more adults	1.80	0.423
No people age 16+ in household		
1 adult with children	-4.50	0.398
1 person household	-0.07	0.972
Other		
3-7 adults with children	-0.50	0.821
3-7 adults aged 20+ with no children	1.12	0.591
3-7 adults aged under 20	-1.59	0.54
2 adults - different gender	1.96	0.341
2 adults - same gender	-0.76	0.733
Unknown	2.69	0.255
Age 80-84		
8 or more adults	-12.58	0

No people age 16+ in household		
1 adult with children	0.97	0.884
1 person household	-0.86	0.754
Other		
3-7 adults with children	-1.27	0.663
3-7 adults aged 20+ with no children	0.49	0.86
3-7 adults aged under 20	4.77	0.181
2 adults - different gender	-0.19	0.945
2 adults - same gender	1.75	0.545
Unknown	1.39	0.641
Age 85+		
8 or more adults	1.31	0.527
8 or more adults No people age 16+ in household	1.31	0.527
8 or more adults No people age 16+ in household 1 adult with children	1.31 14.84	0.527
8 or more adults No people age 16+ in household 1 adult with children 1 person household	1.31 14.84 12.16	0.527
8 or more adults No people age 16+ in household 1 adult with children 1 person household Other	1.31 14.84 12.16	0.527
8 or more adults No people age 16+ in household 1 adult with children 1 person household Other 3-7 adults with children	1.31 14.84 12.16 6.51	0.527 0.002 0 0.003
 8 or more adults No people age 16+ in household 1 adult with children 1 person household Other 3-7 adults with children 3-7 adults aged 20+ with no children 	1.31 14.84 12.16 6.51 10.28	0.527 0.002 0 0.003 0
 8 or more adults No people age 16+ in household 1 adult with children 1 person household Other 3-7 adults with children 3-7 adults aged 20+ with no children 3-7 adults aged under 20 	1.31 14.84 12.16 6.51 10.28 13.15	0.527 0.002 0 0 0.003 0 0
 8 or more adults No people age 16+ in household 1 adult with children 1 person household Other 3-7 adults with children 3-7 adults aged 20+ with no children 3-7 adults aged under 20 2 adults - different gender 	1.31 14.84 12.16 6.51 10.28 13.15 13.52	0.527 0.002 0 0 0.003 0 0 0 0
 8 or more adults No people age 16+ in household 1 adult with children 1 person household Other 3-7 adults with children 3-7 adults aged 20+ with no children 3-7 adults aged under 20 2 adults - different gender 2 adults - same gender 	1.31 14.84 12.16 6.51 10.28 13.15 13.52 10.72	0.527 0.002 0 0 0 0 0 0 0 0 0 0

Ethnicity main effects (reference group – White British)

Variable	Coefficient	Significance
Bangladeshi	-39.33	0
Chinese	-51.95	0

Indian	-50.31	0
Pakistani	-23.86	0
Other Asian heritage	-38.75	0
African	-84.36	0
Caribbean	-48.25	0
Other Black heritage	-59.19	0
Mixed heritage White and Asian	-25.16	0
Mixed heritage White and Black	-51.73	0
Mixed heritage White and Caribbean	-24.55	0
Other mixed heritage	-41.56	0
White Irish	11.30	0.353
Other White heritage	-55.04	0
Any other ethnic group	-81.30	0

Ethnicity/age interactions

Variable	Coefficient	Significance
Bangladeshi age 0	70.93	0
Bangladeshi age 1-4	-0.99	0.487
Bangladeshi age 5-9	-5.85	0
Bangladeshi age 10-14	0.43	0.656
Bangladeshi age 15-19	-2.93	0.004
Bangladeshi age 20-24	-0.85	0.418
Bangladeshi age 25-29	-0.21	0.844
Bangladeshi age 30-34	0.00	0.997
Bangladeshi age 35-39	1.61	0.099
Bangladeshi age 40-44	0.32	0.755
Bangladeshi age 45-49	4.34	0

Bangladeshi age 50-54	6.19	0
Bangladeshi age 55-59	5.57	0.001
Bangladeshi age 60-64	4.33	0.023
Bangladeshi age 65-69	-0.79	0.724
Bangladeshi age 70-74	-23.29	0
Bangladeshi age 75-79	13.96	0
Bangladeshi age 80-84	-14.46	0
Bangladeshi age 85+	-9.03	0.002
Chinese age 0	64.94	0
Chinese age 1-4	0.36	0.888
Chinese age 5-9	-5.69	0
Chinese age 10-14	0.03	0.984
Chinese age 15-19	-1.07	0.486
Chinese age 20-24	-0.86	0.533
Chinese age 25-29	0.14	0.908
Chinese age 30-34	-0.90	0.47
Chinese age 35-39	-2.69	0.027
Chinese age 40-44	-4.89	0
Chinese age 45-49	-6.17	0
Chinese age 50-54	-1.47	0.34
Chinese age 55-59	-0.04	0.983
Chinese age 60-64	-1.33	0.447
Chinese age 65-69	5.55	0.004
Chinese age 70-74	-6.65	0.004
Chinese age 75-79	-2.04	0.488
Chinese age 80-84	6.24	0.073

Development of the formula for	primary care	prescribing for	2025/26 allocations
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Chinese age 85+	1.89	0.457
Indian age 0	64.94	0
Indian age 1-4	2.57	0.008
Indian age 5-9	-5.07	0
Indian age 10-14	1.56	0.019
Indian age 15-19	-2.52	0
Indian age 20-24	-0.87	0.229
Indian age 25-29	-0.20	0.765
Indian age 30-34	-0.32	0.586
Indian age 35-39	-0.91	0.101
Indian age 40-44	0.01	0.992
Indian age 45-49	0.35	0.578
Indian age 50-54	1.22	0.083
Indian age 55-59	4.82	0
Indian age 60-64	1.89	0.016
Indian age 65-69	2.91	0.001
Indian age 70-74	-4.58	0
Indian age 75-79	2.07	0.074
Indian age 80-84	-3.08	0.019
Indian age 85+	-1.40	0.157
Pakistani age 0	53.68	0
Pakistani age 1-4	0.75	0.383
Pakistani age 5-9	-2.87	0
Pakistani age 10-14	0.75	0.187
Pakistani age 15-19	-2.40	0

Pakistani age 20-24	-1.41	0.03
Pakistani age 25-29	-1.93	0.003
Pakistani age 30-34	0.55	0.375
Pakistani age 35-39	-0.37	0.532
Pakistani age 40-44	0.68	0.276
Pakistani age 45-49	2.93	0
Pakistani age 50-54	6.64	0
Pakistani age 55-59	5.83	0
Pakistani age 60-64	6.29	0
Pakistani age 65-69	-0.17	0.882
Pakistani age 70-74	-10.69	0
Pakistani age 75-79	-4.77	0.008
Pakistani age 80-84	-2.05	0.288
Pakistani age 85+	-3.54	0.008
Other Asian heritage age 0	63.30	0
Other Asian heritage age 1-4	-1.02	0.344
Other Asian heritage age 5-9	-5.79	0
Other Asian heritage age 10-14	3.33	0
Other Asian heritage age 15-19	-4.09	0
Other Asian heritage age 20-24	0.26	0.73
Other Asian heritage age 25-29	-0.94	0.178
Other Asian heritage age 30-34	-0.17	0.793
Other Asian heritage age 35-39	-1.02	0.108
Other Asian heritage age 40-44	-1.32	0.044
Other Asian heritage age 45-49	-0.65	0.354
Other Asian heritage age 50-54	3.46	0

Other Asian heritage age 55-59	1.57	0.084
Other Asian heritage age 60-64	1.53	0.139
Other Asian heritage age 65-69	-1.61	0.172
Other Asian heritage age 70-74	-4.84	0
Other Asian heritage age 75-79	-2.84	0.094
Other Asian heritage age 80-84	-1.59	0.434
Other Asian heritage age 85+	1.72	0.289
Black African age 0	71.40	0
Black African age 1-4	2.62	0.007
Black African age 5-9	-3.71	0
Black African age 10-14	-0.75	0.241
Black African age 15-19	-0.32	0.656
Black African age 20-24	-1.59	0.035
Black African age 25-29	0.08	0.912
Black African age 30-34	-1.12	0.115
Black African age 35-39	-2.46	0
Black African age 40-44	-1.89	0.006
Black African age 45-49	-2.23	0.002
Black African age 50-54	2.67	0
Black African age 55-59	1.07	0.219
Black African age 60-64	-1.96	0.071
Black African age 65-69	-3.99	0.005
Black African age 70-74	-3.39	0.062
Black African age 75-79	-3.96	0.072
Black African age 80-84	1.76	0.495
Black African age 85+	-5.80	0.007

Black Caribbean age 0	48.48	0
Black Caribbean age 1-4	-1.08	0.579
Black Caribbean age 5-9	-0.98	0.437
Black Caribbean age 10-14	-3.62	0.002
Black Caribbean age 15-19	-0.09	0.94
Black Caribbean age 20-24	0.32	0.788
Black Caribbean age 25-29	-1.10	0.333
Black Caribbean age 30-34	-0.52	0.638
Black Caribbean age 35-39	-0.69	0.525
Black Caribbean age 40-44	-3.47	0.002
Black Caribbean age 45-49	-0.06	0.954
Black Caribbean age 50-54	3.31	0.001
Black Caribbean age 55-59	1.71	0.07
Black Caribbean age 60-64	-3.41	0.001
Black Caribbean age 65-69	-0.86	0.528
Black Caribbean age 70-74	3.70	0.028
Black Caribbean age 75-79	3.65	0.036
Black Caribbean age 80-84	2.95	0.066
Black Caribbean age 85+	2.39	0.033
Other Black heritage age 0	56.01	0
Other Black heritage age 1-4	0.35	0.858
Other Black heritage age 5-9	-2.90	0.014
Other Black heritage age 10-14	-0.70	0.504
Other Black heritage age 15-19	-0.89	0.378
Other Black heritage age 20-24	0.37	0.715

Other Black heritage age 25-29	-1.26	0.212
Other Black heritage age 30-34	-0.20	0.845
Other Black heritage age 35-39	-1.22	0.24
Other Black heritage age 40-44	-3.07	0.004
Other Black heritage age 45-49	-0.08	0.945
Other Black heritage age 50-54	0.56	0.614
Other Black heritage age 55-59	1.63	0.17
Other Black heritage age 60-64	-0.07	0.964
Other Black heritage age 65-69	-1.75	0.392
Other Black heritage age 70-74	-7.08	0.009
Other Black heritage age 75-79	2.58	0.419
Other Black heritage age 80-84	-0.55	0.874
Other Black heritage age 85+	6.47	0.011
Mixed Asian and White age 0	31.95	0
Mixed Asian and White age 1-4	0.30	0.846
Mixed Asian and White age 5-9	-1.55	0.166
Mixed Asian and White age 10-14	-0.37	0.764
Mixed Asian and White age 15-19	4.71	0.002
Mixed Asian and White age 20-24	-5.99	0.001
Mixed Asian and White age 25-29	0.69	0.702
Mixed Asian and White age 30-34	-2.30	0.211
Mixed Asian and White age 35-39	-3.14	0.1
Mixed Asian and White age 40-44	-5.15	0.013
Mixed Asian and White age 45-49	-0.77	0.733
Mixed Asian and White age 50-54	-4.67	0.059
Mixed Asian and White age 55-59	-5.46	0.046

Mixed Asian and White age 60-64	-4.78	0.133
Mixed Asian and White age 65-69	-9.44	0.012
Mixed Asian and White age 70-74	-5.07	0.249
Mixed Asian and White age 75-79	14.77	0.005
Mixed Asian and White age 80-84	-0.52	0.932
Mixed Asian and White age 85+	-11.68	0.015
Mixed Black African and White age 0	46.09	0
Mixed Black African and White age 1-4	2.68	0.187
Mixed Black African and White age 5-9	-3.08	0.032
Mixed Black African and White age 10-14	1.20	0.442
Mixed Black African and White age 15-19	-1.75	0.352
Mixed Black African and White age 20-24	-2.70	0.212
Mixed Black African and White age 25-29	-0.51	0.823
Mixed Black African and White age 30-34	-0.28	0.902
Mixed Black African and White age 35-39	-3.28	0.142
Mixed Black African and White age 40-44	-2.77	0.223
Mixed Black African and White age 45-49	-5.09	0.036
Mixed Black African and White age 50-54	7.30	0.006
Mixed Black African and White age 55-59	-7.76	0.011
Mixed Black African and White age 60-64	2.96	0.424
Mixed Black African and White age 65-69	-4.72	0.32
Mixed Black African and White age 70-74	-10.55	0.084
Mixed Black African and White age 75-79	-6.56	0.408
Mixed Black African and White age 80-84	-5.36	0.574
Mixed Black African and White age 85+	2.56	0.705

Mixed Black Caribbean and White age 0	22.30	0.002
Mixed Black Caribbean and White age 1-4	-0.71	0.66
Mixed Black Caribbean and White age 5-9	-1.57	0.161
Mixed Black Caribbean and White age 10-14	0.23	0.844
Mixed Black Caribbean and White age 15-19	0.35	0.792
Mixed Black Caribbean and White age 20-24	-2.39	0.095
Mixed Black Caribbean and White age 25-29	-0.41	0.774
Mixed Black Caribbean and White age 30-34	-0.18	0.902
Mixed Black Caribbean and White age 35-39	-1.57	0.344
Mixed Black Caribbean and White age 40-44	-6.42	0.001
Mixed Black Caribbean and White age 45-49	-0.08	0.972
Mixed Black Caribbean and White age 50-54	2.09	0.356
Mixed Black Caribbean and White age 55-59	-2.28	0.349
Mixed Black Caribbean and White age 60-64	-17.92	0
Mixed Black Caribbean and White age 65-69	-19.69	0
Mixed Black Caribbean and White age 70-74	-2.17	0.675
Mixed Black Caribbean and White age 75-79	24.01	0
Mixed Black Caribbean and White age 80-84	3.02	0.599
Mixed Black Caribbean and White age 85+	9.15	0.025
Other mixed heritage age 0	39.94	0
Other mixed heritage age 1-4	0.80	0.461
Other mixed heritage age 5-9	-1.60	0.043
Other mixed heritage age 10-14	0.66	0.452
Other mixed heritage age 15-19	-0.74	0.463
Other mixed heritage age 20-24	-1.50	0.172
Other mixed heritage age 25-29	-0.60	0.582

0.25	0.816
-3.25	0.004
-1.57	0.203
-3.39	0.013
2.85	0.06
-1.36	0.426
-3.59	0.072
3.17	0.177
-3.89	0.159
-0.89	0.79
8.89	0.018
-3.69	0.119
-12.75	0.4
2.35	0.457
-1.37	0.533
-2.77	0.215
5.92	0.009
-3.85	0.069
-2.49	0.165
0.46	0.773
-1.52	0.318
-3.28	0.035
3.51	0.026
0.42	0.785
1.16	0.442
1.73	0.259
	0.25 -3.25 -1.57 -3.39 2.85 -1.36 -3.59 3.17 -3.89 -0.89 8.89 -0.89 8.89 -0.89 8.89 -0.40 -0.40 -0.40 -0.40 -0.40 -0.40 -0.40 -0.42

White Irish age 65-69	2.70	0.078
White Irish age 70-74	-1.92	0.193
White Irish age 75-79	5.34	0
White Irish age 80-84	0.78	0.631
White Irish age 85+	0.42	0.728
Other White heritage age 0	52.99	0
Other White heritage age 1-4	0.61	0.294
Other White heritage age 5-9	-2.63	0
Other White heritage age 10-14	0.38	0.392
Other White heritage age 15-19	-0.30	0.542
Other White heritage age 20-24	0.20	0.676
Other White heritage age 25-29	-1.82	0
Other White heritage age 30-34	-1.06	0.002
Other White heritage age 35-39	-2.42	0
Other White heritage age 40-44	-3.14	0
Other White heritage age 45-49	-1.83	0
Other White heritage age 50-54	0.72	0.113
Other White heritage age 55-59	-0.07	0.891
Other White heritage age 60-64	-1.49	0.01
Other White heritage age 65-69	1.19	0.073
Other White heritage age 70-74	2.68	0
Other White heritage age 75-79	-0.03	0.969
Other White heritage age 80-84	3.47	0
Other White heritage age 85+	0.95	0.137
Any other ethnic group age 0	64.92	0

Any other ethnic group age 1-4	3.21	0.015
Any other ethnic group age 5-9	-5.03	0
Any other ethnic group age 10-14	-1.16	0.187
Any other ethnic groupage 15-19	1.61	0.059
Any other ethnic group age 20-24	-0.16	0.852
Any other ethnic group age 25-29	-0.56	0.471
Any other ethnic group age 30-34	-1.59	0.035
Any other ethnic group age 35-39	-2.95	0
Any other ethnic group age 40-44	-3.70	0
Any other ethnic group age 45-49	-4.77	0
Any other ethnic group age 50-54	-3.24	0.001
Any other ethnic group age 55-59	-1.95	0.091
Any other ethnic group age 60-64	-6.67	0
Any other ethnic group age 65-69	-5.05	0.002
Any other ethnic group age 70-74	-0.54	0.787
Any other ethnic group age 75-79	-4.85	0.057
Any other ethnic group age 80-84	2.27	0.47

Diagnoses

Variable	Coefficient	Significance
a00_a09 Intestinal infectious diseases	49.75	0
a15_a19 Tuberculosis	-89.74	0
a20_a49 Certain bacterial diseases	51.72	0
a50_a64 Infections with predominantly sexual mode of		
transmission	-173.78	0.22
a65_a79 Other infectious and parasitic disorders	-57.22	0
a80_a89 Viral infections of the central nervous system	-100.30	0

a90_a99 Arthropod-borne viral fevers and viral haemorrhagic fevers	-77.03	0.001
b00_b09 Viral infections characterized by skin and mucous		
membrane lesions	22.73	0
b15_b19 Viral hepatitis	18.50	0
b25_b34 Other viral diseases	17.94	0
b35_b49 Mycoses	186.19	0
b50_b64 Protozoal diseases	-92.74	0
b65_b83 Helminthiases	-88.01	0
b85_b99 Other infectious and parasitic diseases	60.55	0
c00_c14 Malignant neoplasm of liporal cavity and	204.57	0
c15_c26 Malignant neoplasm of digestive organs	197.95	0
c30_c39 Malignant neoplasms of respiratory and		
intrathoracic organs	33.05	0
c40_c41 Malignant neoplasm of bone and articular	65.51	0
c43_c44 Malignant neoplasms of skin	-59.80	0
c45_c49 Malignant neoplasms of mesothelial and soft tissue	-43.30	0
c50 Malignant neoplasm of breast	-53.19	0
c51_c58 Malignant neoplasms of female genital organs	-38.67	0
c60_c63 Malignant neoplasms of male genital organs	60.74	0
c64_c68 Malignant neoplasms of urinary tract	-45.93	0
c69_c72 Malignant neoplasms of eye, brain and other parts		
of the central nervous system	132.38	0
c73_c80 Malignant neoplasm of thyroid and other endocrine		
glands	110.18	0
c81_c96 Malignant neoplasms of lymphoid, haematopoietic and related tissue	-128.37	0
d00_d48 In situ and benign neoplasms and others of		
uncertainty	-38.99	0

d50_d64 Anaemias	21.15	0
d65_d89 Diseases of the blood and blood-forming organs	7.14	0
e00_e07 Disorders of thyroid gland	32.47	0
e10_e14 Diabetes Mellitus	486.82	0
e15_e90 Endocrine nutritional and metabolic diseases	28.66	0
f00_f03 Dementia	-105.50	0
f04_f09 Other organic including symptomatic mental disorders	-133.09	0
f10_f19 Mental and behavioural disorders due to psychoactive substances	-25.90	0
f20_f29 Schizophrenia, schizotypal and delusional disorders	114.85	0
f30_f39 Mood disorders	69.92	0
f40_f69 Neurotic, behavioural and personality disorders	11.01	0
f70_f79 Mental retardation	672.00	0
f80_f99 Other mental and behavioural disorders	585.64	0
g00_g09 Inflammatory diseases of the central nervous system	100.70	0
g10_g14 Other degenerative diseases (including Alzheimer's)	214.10	0
g20_g26 Extrapyramidal and movement disorders (including Parkinsonism)	636.37	0
g35_g37 Demyelinating diseases (including Multiple Sclerosis) of the central nervous system	512.10	0
g40_g47 Epilepsy, migraine and other episodic disorders	270.12	0
g50_g73 Other diseases and disorders of the nervous system	121.06	0
g80_g83 Cerebral palsy and other paralytic syndromes	867.55	0
h00_h06 Other disorders of the eye	75.35	0
h10_h13 Disorders of conjunctiva (including conjunctivitis)	-2.26	0.372

h25_h28 Disorders of lens (including cataracts)	-64.63	0
h40_h42 Glaucoma	57.44	0
h60_h95 Diseases of the ear and mastoid process	-21.14	0
i00_i09 Rheumatic heart disease	-54.44	0
i10_i15 Hypertensive diseases	-18.67	0
i20_i25 Ischaemic heart diseases	48.94	0
i26_i28 Pulmonary heart disease and diseases of pulmonary circulation	137.31	0
i30_i52 Other forms of heart disease	158.53	0
i60_i69 Cerebrovascular diseases	-182.04	0
i70_i79 Diseases of arteries, arterioles and capillaries	17.31	0
i80_i89 Diseases of veins and lymphatic system not elsewhere classified	68.67	0
i95_i99 Other and unspecified disorders of the circulatory system	15.42	0
j00_j06 Acute upper respiratory infections	0.64	0.46
j09_j18 Influenza and pneumonia	66.34	0
j20_j22 Other acute lower respiratory infections	117.13	0
j30_j39 Other diseases of upper respiratory tract	-21.83	0
j40_j47 Chronic lower respiratory diseases	187.32	0
j60_j70 Lung diseases due to external agents	673.32	0
j80_j99 Other diseases of the respiratory system	69.46	0
k00_k14 Diseases of oral cavity, salivary glands and jaws	16.75	0
k20_k31 Diseases of oesophagus, stomach and duodenum	56.06	0
k35_k38 Diseases of appendix	-89.70	0
k40_k46 Hernia	-29.30	0
k50_k52 Noninfective enteritis and colitis	271.70	0
k55_k64 Other diseases of intestines	19.73	0

k65_k67 Diseases of peritoneum	60.89	0
k70_k77 Diseases of liver	70.88	0
k80_k87 Disorders of gall bladder, biliary tract and pancreas	7.08	0
k90_k93 Other diseases of the digestive system	109.82	0
100_114 Other infections and disorders of the skin	48.13	0
I20_I30 Dermatitis and eczema	6.67	0
I40_I45 Papulosquamous disorders (including Psoriasis)	78.18	0
I50_I54 Urticaria and erythema	53.13	0
m00_m25 Arthropathies	-19.37	0
m30_m36 Systemic connective tissue disorders	63.61	0
m40_m54 Dorsopathies	45.14	0
m60_m79 Soft tissue disorders	47.20	0
m80_m94 Osteopathies and chondropathies	83.83	0
m95_m99 Other disorders of the musculoskeletal system		
and connective tissues	-32.16	0
n00_n08 Diseases of the kidney	47.59	0
n17_n19 Renal failure	28.40	0
n20_n23 Urolithiasis	-28.64	0
n25_n29 Other disorders of kidney and ureter	7.12	0
n30_n39 Other diseases of the urinary system	101.46	0
n40_n51 Diseases of male genital organs	-56.04	0
n60_n64 Disorders of breast	-16.40	0
n70_n77 Inflammatory diseases of female pelvic organs	-39.50	0
n80_n98 Noninflammatory disorders of female genital tract	-37.77	0
n99 Other disorders of the genitourinary system	201.97	0
o00_o08 Pregnancy with abortive outcome	-37.97	0
o10_o75 Complications of labour and delivery	-21.34	0
o80_o84 Delivery	-2.90	0.169

p00_p04 Complications of foetus/neonate	-13.65	0
p05_p96 Other conditions originating in the perinatal period	14.51	0
q00_q89 Congenital malformations	175.68	0
q90_q99 Chromosomal abnormalities not elsewhere classified	638.57	0
r00_r09 Symptoms and signs involving the circulatory/respiratory system	-6.70	0
r10_r19 Symptoms and signs involving the digestive system and abdomen	15.73	0
r20_r23 Symptoms and signs involving the skin and subcutaneous tissue	-26.14	0
r25_r29 Symptoms and signs involving the nervous and musculoskeletal system	30.68	0
r30_r39 Symptoms and signs involving the urinary system	15.10	0
r40_r46 Symptoms and signs involving cognition, perception, emotional state and behaviour	-37.46	0
r47_r49 Symptoms and signs involving speech and voice	-56.70	0
r50_r68 General symptoms and signs	30.18	0
r69 Unknown and unspecified causes of morbidity	182.92	0
r70_r89 Abnormal findings of bodily fluids or samples without diagnosis	7.68	0
r90_r94 Abnormal findings on diagnostic imaging/function studies	-17.82	0
r95_r99 III defined and unknown causes of mortality	-213.08	0.073
s00_s09 Injuries to the head	-9.78	0
s10_s19 Injuries to the neck	6.79	0.046
s20_s29 Injuries to the thorax	-10.40	0
s30_s39 Injuries to abdomen, lower back, lumbar spine and pelvis	-6.12	0
s40_s49 Injuries to the shoulder and upper arm	-21.04	0

s50 s59 Injuries to the elbow and forearm -25.96 0 -18.71 s60_s69 Injuries to the wrist and hand 0 s70_s79 Injuries to the hip and thigh -22.81 0 s80_s89 Injuries to the knee and lower leg 0 -24.47 s90_s99 Injuries to the ankle and foot 15.87 0 t00_t07 Injuries involving multiple body regions -9.63 0.01 0.019 t08_t14 Injuries to unspecified part of trunk limb or body 11.29 t15_t19 Effects of foreign body entering through natural orifice 89.05 0 t20_t32 Burns and corrosions -11.59 0 -170.27 0.002 t33_t35 Frostbite t36_t50 Poisonings by drugs medicaments and biological substances -3.68 0.011 t51_t65 Toxic effects of substances chiefly non-medicinal as 0 to source -41.37 0 t66_t78 Other and unspecified effects of external causes 24.91 t79 Certain early complications of trauma -81.16 0 t80_t88 Complications of surgical and medical care not elsewhere classified 145.71 0 t90 t98 Sequelae of injuries of poisoning and other consequences 248.65 0 VVV -47.18 0 WWW -41.65 0 XXX 7.47 0 YYY 0 6.95 -2.60 0 z00_z13 Examination and investigation z20_z29 Potential health hazards related to communicable diseases 55.09 0

z30_z39 Health services in circumstances related to		
reproduction	-54.50	0
z40_z54 Persons encountering health services for specific		
care	27.55	0
z55_z65 Potential health hazards related. to socioeconomic		
and psychosocial circumstances	-50.99	0
z70_z76 Persons encountering health services in other		
circumstances	22.75	0
z80_z99 Persons with potential health hazards related to		
family	39.60	0
U Unclassified	176.47	0
Covid diagnosis	251.62	0

Attributed need variables

Variable	Coefficient	Significance
The difference between the logged registered population		
and the logged resident population	-15.76	0
QOF prevalence - palliative care	3.46	0
QOF prevalence - hypertension	0.23	0
QOF prevalence - mental health	2.28	0
% with GP appointment in last 3 months	8.52	0
GP survey - % with a long term condition	11.55	0
GP survey - average number of long term conditions for		
those with at least 1	0.97	0.001
IMD - Road distance to general store or supermarket	-1.36	0
IMD - Homelessness indicator	0.47	0
IMD - % with no qualifications	0.00	0
IMD - income score	-58.98	0
Census - % never worked or long term unemployed	-22.63	0

IMD - years of potential life lost	0.05	0
Census - disabled persons in poor health	0.00	0
IMD - housing in poor condition	-9.36	0
Census - % unpaid carers	0.00	0
Census - % single pensioner households	-50.39	0
Census - % full time students	18.26	0
Census - % single - never married	-56.01	0
DWP - % Disability Living Allowance/Personal Incentive		
Payment	2.91	0

Property type and tenure

Variable	Coefficient	Significance
Property type/tenure interaction		
Detached and owner occupied	-61.90	0
Detached and private rented	-50.92	0
Detached and social rented	35.77	0
Detached and unknown tenure	-65.92	0
Semi-detached and owner occupied	-56.08	0
Semie-detached and private rented	-51.90	0
Semi-detached and social rented	-0.46	0.528
Semi-detached and unknown tenure	-43.38	0
Terraced and owner occupied	-53.55	0
Terraced and private rented	-52.30	0
Terraced and social rented	-8.00	0
Terraced and unknown tenure	-33.75	0
Flat and owner occupied	-52.06	0
Flat and private rented	-50.03	0

Flat and social rented	-10.53	0
Flat and unknown tenure	-19.96	0
Other property types		
Educational establishment	-36.43	0
Temporary accommodation	-48.41	0
Sheltered accommodation	51.34	0
Military establishment	-51.24	0.018
Medical establishment	-73.29	0
Commercial establishment	-80.23	0
Other	-37.72	0
Unknown	-48.58	0

Attributed supply variables

Variable	Coefficient	Significance
% 12-18 months with MMR vaccine	0.04	0
% 80 year olds with shingles vaccine	-0.02	0
Number of FTE nurses in GP practice	0.12	0
GP access supply variable	-1.19	0
IMD - road distance to GP surgery	-0.74	0

ICBs (reference group Northamptonshire ICB)

Variable	Coefficient	Significance
Bath and North East Somerset, Swindon and Wiltshire ICB	0.47	0.451
Bedfordshire, Luton and Milton Keynes ICB	16.01	0
Birmingham and Solihull ICB	11.83	0

Black Country ICB	13.76	0
Bristol, North Somerset and South Gloucestershire ICB	6.48	0
Buckinghamshire, Oxfordshire and Berkshire West ICB	12.42	0
Cambridgeshire and Peterborough ICB	5.52	0
Cheshire and Merseyside ICB	-4.63	0
Cornwall and The Isles Of Scilly ICB	18.98	0
Coventry and Warwickshire ICB	5.92	0
Derby and Derbyshire ICB	31.89	0
Devon ICB	20.08	0
Dorset ICB	6.38	0
Frimley ICB	17.38	0
Gloucestershire ICB	7.95	0
Greater Manchester ICB	10.23	0
Hampshire and Isle Of Wight ICB	13.46	0
Herefordshire and Worcestershire ICB	6.63	0
Hertfordshire and West Essex ICB	18.81	0
Humber and North Yorkshire ICB	11.39	0
Kent and Medway ICB	15.08	0
Lancashire and South Cumbria ICB	4.53	0
Leicester, Leicestershire and Rutland ICB	20.65	0
Lincolnshire ICB	21.41	0
Mid and South Essex ICB	5.23	0
Norfolk and Waveney ICB	4.91	0
North Central London ICB	8.32	0
North East London ICB	16.55	0
North East and North Cumbria ICB	3.35	0
North West London ICB	-6.67	0

Nottingham and Nottinghamshire ICB	2.19	0.051
Shropshire, Telford and Wrekin ICB	10.21	0
Somerset ICB	28.77	0
South East London ICB	16.35	0
South West London ICB	-1.14	0.119
South Yorkshire ICB	12.80	0
Staffordshire and Stoke-on-Trent ICB	10.71	0
Suffolk and North East Essex ICB	22.70	0
Surrey Heartlands ICB	15.60	0
Sussex ICB	9.59	0
West Yorkshire ICB	10.82	0