ACRA(2015)11

MEETING: Advisory Committee on Resource Allocation
DATE OF MEETING: 22 July 2015
TITLE OF REPORT/PAPER: ACRA(2015)11 : Public health formula for the summer engagement
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ACTIONS REQUIRED: It is anticipated that there will be an engagement in the summer on the public health formula. This paper seeks confirmation of ACRA's interim recommendations to be included in this engagement.

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PUBLIC HEALTH FORMULA FOR 2016-17

INTRODUCTION

1. This paper seeks confirmation of ACRA's interim recommendations to be included in an engagement over the summer for the formula for public health allocations for 2016-17 to Local Authorities. Options for the interim recommendations were discussed in detail at ACRA's meeting in April.

2. The responses to the public engagement over the summer will be fed back to ACRA in September, to assist ACRA in making its final recommendations on the formula this autumn.

3. Annex A of this paper is an initial draft of ACRA's initial recommendations for the engagement and Annex B responds to the questions raised at ACRA's April meeting. An Exposition book setting out the calculation of the weighted populations will be published as part of the summer engagement.

4. Figure 1 in Annex A summarises the proposed changes in the formula from that used for 2013-14 and 2014-15 target allocations.

ACTION FOR ACRA

5. ACRA is asked to finalise the initial recommendations for the summer engagement.

6. The areas on which ACRA's views are particularly requested are:

    a. the proposal that the actual SMR<75 is used, and not modelled SMR<75;

    b. the proposed that the number of MSOA groups for the SMR<75 is extended from 10 to 16, and weight per head extended from 5 : 1 to 9.43 : 1;

    c. the measure and scaling of the need per head for the formula for public health for children under the age of 5;

    d. whether to include a sparsity adjustment in the formula for public health for children under the age of 5.

ANNEX A: DRAFT OF ACRA'S INITIAL RECOMMENDATIONS FOR FORMULA FOR 2016-17

1. The following section summarises the formula recommended by ACRA in 2012 and used to set target allocations for 2013-14 and 2014-15. We then set out ACRA's interim recommendations for the formula for 2016-17, for which there are proposed changes to the current formula, as well as data updates, in the form of:

    - a new formula for sexual health services;
    - a new formula for substance misuse treatment services;
    - a revision to the way the SMR<75 is applied;
    - the new component for public health services for children aged under 5.

The formula for 2013-14 and 2014-15 allocation

2. ACRA developed a new public health formula in 2012 which was used to set target allocations for 2013-14 and 2014-15 for public health grants to Local Authorities. As with other formulae, it is on a weighted capitation basis. Full details of the formula are published at: https://www.gov.uk/government/publications/ring-fenced-public-health-grants-to-local-authorities-2013-14-and-2014-15

3. A summary of the current formula is as follows:

    a. the principal indicator of need is the standardised mortality ratio (SMR) for those aged under 75 years;

    b. the SMR<75 is applied at MSOA level to take account of inequality within Local Authorities as well as between Local Authorities;

    c. the gradient of the formula across small areas is exponentially weighted at a ratio of 5:1 to target funding per head towards areas with the poorest health outcomes;

    d. the weighted population for Local Authorities is built up from the weighted populations for the MSOAs in their area;

    e. an age-gender adjustment is applied for those services with the highest proportion of public health spend which are also directed at specific age-gender groups to weight for relative needs between different age-gender groups;

    f. a component to support drug treatment services funded through the pooled treatment budget up to 2012-13 which broadly follows the approach used to allocate that budget. This is based on a need

component, an activity component and an outcome component. The need component was replaced with the SMR<75;

g. an unavoidable cost adjustment is used in the formula, the Market Forces Factor;

h. the weights per head are applied to Office for National Statistics (ONS) resident population projections for Local Authorities to give weighted populations for each Local Authority. Each Local Authority's share of the total weighted population gives its target share of the national budget (once known).

4. The formula is principally based on a population health measure, the SMR<75. Many of the mortality and morbidity measures are highly correlated, but the SMR<75 has the important practical advantage that it is updated regularly, including at middle level super output area (MSOA). MSOAs are small geographical areas defined by the Office for National Statistics for statistical analysis and reporting purposes, and on average have a population of around 8,000 people. The SMR<75 is used as an indicator of the whole population's health status and should not be interpreted as meaning that the allocation should not reflect the needs of those aged over 75 years or that morbidity is unimportant.

5. The SMR<75 is applied to give a weight per head for each MSOA. Each MSOA was assigned to one of ten groups based on their SMR<75. The MSOAs in the group with the worst SMR<75s were given a weight per head of 5 times that for the MSOAs in the group with the lowest SMR<75s. The weights per head increased exponentially across the intervening eight groups, which means the differences in the weights between each of the groups increases as the SMR<75 rises.

6. Age-gender adjustments were applied for obesity and physical activity, alcohol misuse, tobacco misuse, sexual health services, children's 5-19 services, and drugs misuse.

7. The MFF is that used in NHS allocations to Clinical Commissioning Groups, mapped to Local Authorities. This was preferred to the Area Cost Adjustment in the Local Government formula as it should be updated more frequently.

Recommended changes to the formula for 2016-17

8. ACRA has recommended three main changes to the current formula. A new component for public health services for children aged under 5 needs to be included in the overall formula, following the transfer of responsibility for commissioning these services to Local Authorities from October 2015.

9. The three main changes are a new formula for sexual health services, a new formula for substance misuse treatment services, and a revision to the way the SMR<75 is applied. A summary of ACRA's proposed changes is in Figure 1, which also includes the preliminary shares or weights for each component to

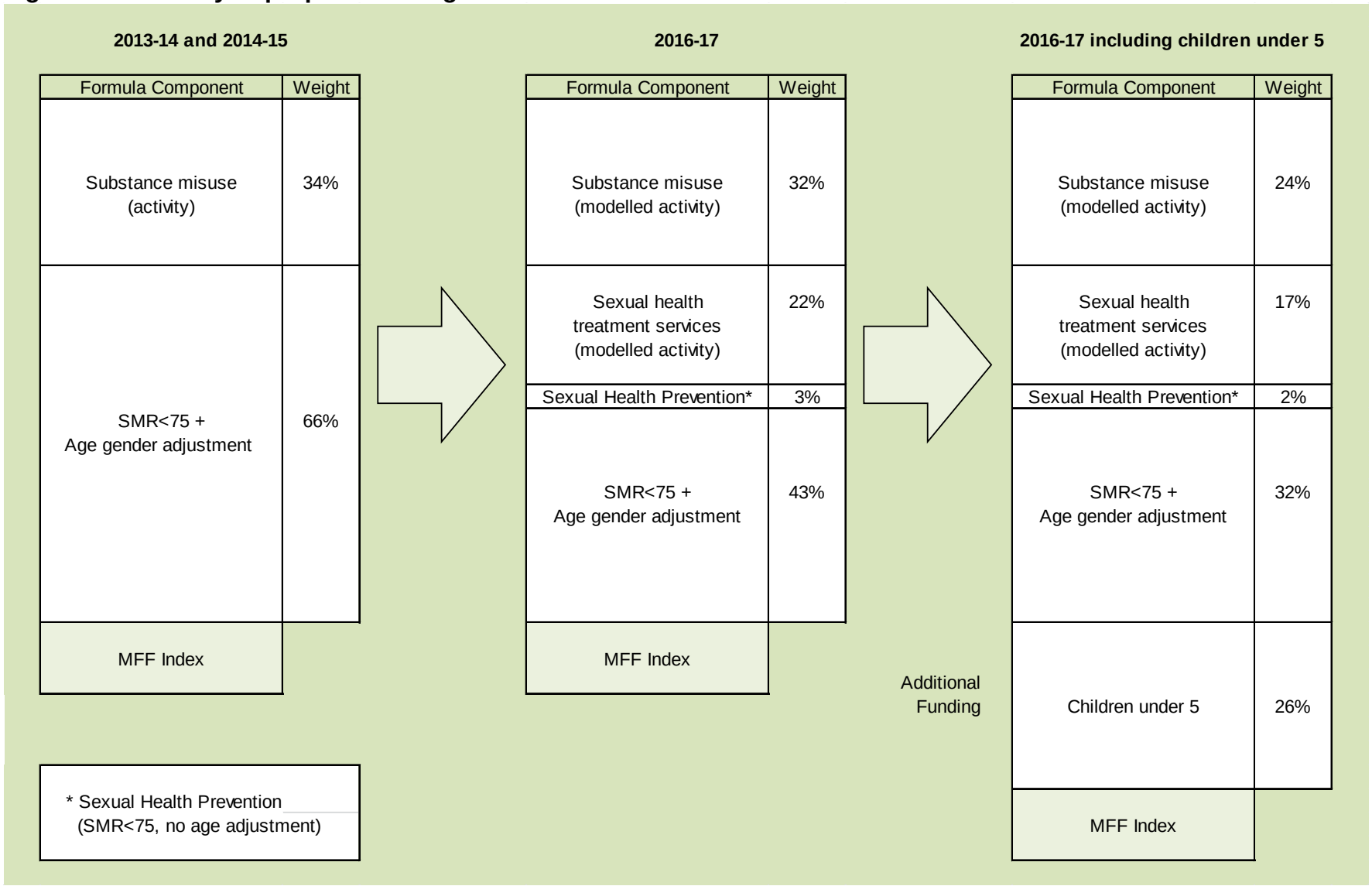
combine these into a single overall formula. The weights are from 2013-14 expenditure, except for services for children under 5 which is based on 2015-16 budgets. Each of the changes is set out in turn below.

10. The current formula is based on an element of judgement and one of the recommendations made by ACRA in 2012 was to develop a more evidence based formula. The new proposed components for sexual health services and substance misuse services are based on research commissioned from the University of Manchester. Research was commissioned for these two services because they both represent a large share of total expenditure and good data have now become available on these services. In addition, there is a good case that need for sexual health services is not well represented by the SMR<75.

11. The research report from the University of Manchester is published with this engagement.

12. The population base will continue to be the population projections at Local Authority Level by the ONS for the year of the allocations. The data used in the current formula has been updated, such as the SMR<75 and the age-gender weights.

Figure 1: Summary of proposed changes to the formula



Substance misuse services

13. The University of Manchester developed an utilisation based formula for individual treatment services for drugs and alcohol misuse. This involved modelling the use of these treatment services using data on the characteristics of clients, their place of residence, and supply variables. Supply variables are included in the model to account for the possibility of supply induced demand, but are not included in the formula for target allocations.

14. The selection of the explanatory variables to be tested was based on the available research on the characteristics of treatment service clients. A wide range of potential need variables were tested and the final selection chosen on the basis of statistical criteria.

15. ACRA felt that the component of the overall formula for substance misuse based on modelled activity is an improvement on the component being based on actual activity, as is the case with the current formula.

The data

16. The activity data are for 2013-14 from the National Drug Treatment Monitoring System (NDTMS). This dataset covers Tier 3 (structured community-based services) and Tier 4 services (residential treatment), for which NDTMS is considered near comprehensive. Those aged under 9 and over 75 years are excluded from the NDTMS dataset. The 2013-14 dataset covers around 193,000 clients engaging in approximately 270,000 treatment episodes.

17. As NDTMS does not include information of the client's LSOA or full postcode, so the geographical unit of analysis was postcode sector/local authority combinations (n = 10,039 areas). Postcode sectors are exclusive of the last two characters, e.g. LS2 7.

The models

18. A number of models were developed by the researchers. ACRA recommended that a single model for drug and alcohol treatment services should be used rather than separate models for drugs and for alcohol misuse services. This was due to concerns over the robustness of the models only for alcohol services and because spend data from local authority returns are only available at the combined level.

19. The researchers developed models based on three methodologies.

    Model 1. Age-standardised model

    The dependent variable is the ratio of actual to expected cost for each postcode sector / Local Authority combination. Expected cost was obtained by calculating national costs per capita for eight age bands (under 15, 15 to 19, 20 to 24, 25 to 29, 30 to 44, 45 to 59, 60 to 64, 65 and above) and applying these national average costs to each area's population. Need and supply variables at area

level were then tested to explore how well they predicted the actual to expected cost ratio.

Model 2. Age-stratified model

Separate models were developed for those aged 18 and over and those aged under 18.

Model 3. Person-based model

The dependent variable is the actual cost per person, not the ratio of actual to expected cost. Case-level data for those with treatment records are combined at area level with data by age group for those with no treatment records. Past-year treatment utilisation is applied at case level.

20. ACRA preferred the person-based approach due to it being a statistically superior model. This was largely due to the inclusion of individual level characteristics data, including past use of services. Past use of addiction services is known as an important predictor of future use.

21. In developing the person-based model, the researchers added further explanatory variables in each step. ACRA preferred the person-based model with the full-set of variables to avoid over-reliance on past use. The need variables included in the preferred model are shown in Table 1, along with whether they increase target allocation per head ('plus' in the table) or lower target allocations per head ('minus' in the table).

Table 1: Need variables in preferred substance misuse formula

Variable	Need
Days of treatment previous year (12/13)	+
Completed treatment previous year (12/13)	-
Received prescribing previous year (12/13)	+
SMR	+
Population turnover	+
Proportion male	+
Age 15-19	+
Age 20-24	+
Age 25-29	+
Age 30-44	+
Age 45-59	+
Age 60-64	+
Age 65+	-

22. It was not possible for formula for substance misuse to model need for the Isles of Scilly and the City of London due to their small population sizes. An alternative approach would be needed for these Local Authorities.

Sexual health services

23. The responses to the engagement exercise undertaken in 2012 on the proposed formula for 2013-14 included a strong view from some areas that the SMR<75 was not correlated with the need for sexual health services. The research commissioned from the University of Manchester developed an utilisation based formula for individual sexual health services. As for substance misuse treatment services, this involved modelling the use of these treatment services using data on the characteristics of clients, their place of residence, and supply variables. Supply variables are included in the model to account for the possibility of supply induced demand, but are not included in the formula for target allocations.

24. ACRA recommended that new models of activity were an improvement on using the SMR<75 plus an age-gender adjustment for sexual health treatment services component in the overall formula.

The data

25. The data are for 2013-14 from GUMCADv2 and CTAD. The GUMCADv2 data set used had level 3 diagnoses and services provided, i.e. the activity in GUM clinics. While level 2 data are now collected in GUMCADv2, these data were not available at the time the research was undertaken. Level 2 covers enhanced GP service, sexual and reproductive health services, young people's services and others (e.g. outreach programmes).

26. The Chlamydia Testing and Activity Dataset (CTAD) covers all GUM and non-GUM clinic chlamydia testing in England. Both GUMCADv2 and CTAD include patients' LSOA. Data at the level of detail required from the Sexual and Reproductive Health Activity Dataset (SRHAD) were not available at the time the research was undertaken. SRHAD complements GUMCADv2 by including data on sexual health and reproductive services provided in the community.

The models

27. The researchers developed models based on three approaches:

    Model 1: Person-based – GUMCADv2

    Model 2 : Person-based – GUMCADv2 and CTAD

    Model 3 : Small geographical area based - LSOA-age-gender level, using GUMCADv2 and CTAD

28. The explanatory variables chosen for testing was based on key drivers highlighted in reports by Public Health England and the sexual and health profiles tool. A wide range of potential need variables were tested and the final selection chosen on statistical grounds.

29. ACRA preferred Model 2 – person-based GUMCADv2 and CTAD. The person-based model using only GUMCADv2 data excludes chlamydia testing outside GUM clinics. The LSOA based model loses all information on historic activity and variations in need by age gender groups in LSOAs and was not favoured by ACRA.

30. The need variables included in the preferred model are shown in Table 2, along with whether they increase target allocation per head ('plus' in the table) or lower target allocations per head ('minus' in the table).

Table 2: Need variables in preferred sexual health services

Variable	Need
IMD 2010 environment score	+
Jobseekers allowance claimants (2010 rate)	+
Average houshold size	-
Proportion black/carribean	+
Propotion same-sex civil partnership	+
Patient 2012-13	+
Female	+
Age 0-14	-
Age 15-19	+
Age 20-24	+
Age 35-44	-
Age 45-64	-
Age 65-99	-

31. It was not possible for formula for sexual health service to model need for the Isles of Scilly and the City of London due to their small population sizes. An alternative approach would be needed for these Local Authorities.

32. The different components of the overall formula are combined into a single formula using the most recent expenditure data available. Local Authorities report expenditure in three categories for sexual health services: STI testing and treatment; contraception; and advice, prevention and promotion. ACRA recommended that there are two components in the overall model for the sexual health services. One component would cover STI testing and treatment and contraception and use the formula developed by the University of Manchester. The second component wold be for advice, prevention and promotion, for which the SMR<75 without an age-gender adjustment would be used. ACRA felt that the utilisation formula for treatment services would not be an appropriate base for advisory, prevention and promotion services.

SMR<75 bands

33. As set out above, the public health formula recommended by ACRA in 2012 is largely based on the SMR for those aged under 75. The SMR<75 was applied at MSOA level to take account of inequality within as well as between local authorities.

34. Each MSOA was assigned to one of ten groups based on the value of their SMR<75. MSOAs in the same group were given the same weight per head. MSOAs in the group with the highest SMR<75s were given a weight per head 5 times higher than the MSOAs in the group with the lowest SMR<75s. The weight per head for the intermediate group increased exponentially.

35. It had intended that the each group would be equal width in terms of the range of SMR<75s they covered. However, a rule was applied that none of the ten groups should contain fewer than 5% of the total number of MSOAs. This was intended to reduce the impact of random fluctuations in the SMR<75 over time and remove the effect of outliers which may be due to data issues.

36. The condition that none of the ten groups should contain fewer than 5% of the total number of MSOAs resulted in the two groups with the lowest and highest MSOAs each covering a wide range of SMR<75s.

37. ACRA has reviewed the grouping of the MSOAs by SMR<75 and found the condition applied previously was too cautious[1]. ACRA has recommended that there should instead be 16 groups with a more similar span of SMR<75 in each group. Extrapolating the former ratio of 5 : 1 across 10 groups gives a ratio of 9.43 : 1 between the new group with the highest SMR<75s and the new group with the lowest SMR<75s.

Public health services for children aged under 5 years

Introduction

38. The responsibility for commissioning public health services for children aged under 5 years (commonly referred to '0-5 children's services') transfers from NHS England to Local Authorities from October 2015. The budgets for October 2015 to March 2016 are primarily on the basis of 'lift and shift.' A component for 0-5 children's services to the overall public health formula will first be introduced in 2016-17.

39. There was a short engagement with Local Authorities in March 2015, with a focus on seeking evidence for the formula.

40. The formula proposed by ACRA has three elements:

    • the population base;

    • an adjustment for relative need per head of the population base;

    • sparsity - subject to materiality

41. Each is discussed in turn below.

[1] ACRA is grateful to Mr John Hacking for a paper submitted on this issue.

Population base

42. The proposed population base is the number of children aged under 5 in each Local Authority, as projected by ONS. The aim is to improve the health and well-being of all children aged under 5 years. The logical population base therefore is the number of children aged under 5 in each Local Authority.

43. The potential higher costs of children moving into an area has been raised, the higher costs arising from the need to undertake entirely new reviews of the child's health and well-being. Data are available on the number of children moving into a Local Authority, but data on moves within a Local Authority are only available from the Population Census .

44. ACRA is not aware of quantified evidence that costs are higher and the scale of such costs. In the absence of evidence on costs, ACRA has not recommended that there is an adjustment to the formula for the number of children moving into the area.

Relative need per head

45. In addition to universal services, resources for public health for 0-5 children are targeted towards families with higher need and vulnerable first time mothers. ACRA propose that there should be an adjustment for relatively higher need by some families for 0-5 children's public health services, and that this adjustment is likely to be higher in more deprived areas.

46. There is no ideal measure of relative need per head. ACRA currently favours the use of the child poverty, defined as the proportion of under 16 years living in families in receipt of out of work benefits or tax credits where their income is less than 60% of median income. The latest data are for 2012. This measure is included in the Public Health Outcomes framework. Data on the proportion of children under 5 in poverty are not available.

47. ACRA also considered the proportion of live births at term which are low birth weight and the number of births to women aged under 20 years. However, data on these were felt to be too volatile at Local Authority level due to small numbers and not broad enough to capture all children with higher need. The IMD2010 indices, which are based on data for around 2008, were felt to be too dated. The date of publication of the IMD 2015 indices has not yet been finalised.

48. Children in need of support from social services and children in need of safeguarding and subject to a child protection plan were also considered, but not recommended due to concerns over the variability between Local Authorities in the interpretation of the definition of, and routes to identify, children in need and in need of a child protection plan.

49. There are a number of issues with the child poverty measure. It is a binary measure; children are classified as being in poverty or not, and no account is taken of the depth of poverty of those in poverty which may vary between

areas. The definition of child poverty is to be replaced and the measure will also be affected by changes to the benefits system. However, despite these issues ACRA currently views child poverty as preferable to other measures.

50. The measure needs to be scaled – how much higher should be the weight per head for children in poverty compared with children not in poverty. ACRA has found little evidence to support a particular weighting and an element of judgement is required.

51. Advice from Public Health England has suggested a ratio of 3 to 1. This means children in poverty receive a weight per head three times higher than children not in poverty. Others have suggested a higher ratio, such as 5 : 1.

52. ACRA would welcome further advice on the weights, which will be a matter of judgement, before reaching its final recommendations.

53. ACRA is not recommending a separate component in the formula for Family Nurse Partnerships due to lack of materiality in the overall formula.

Sparsity

54. Sparsity may create unavoidable differences in the costs of providing some 0-5 children's public health services between Local Authorities, in particular where health visitors travel for home visits. Travel time is likely to be longer in sparsely populated areas, and possibly major conurbations. The MFF does not take account unavoidable costs due to sparsity. ACRA has developed an approach to test the materially of an adjustment for sparsity.

55. Data on health visitors' travel times are not held centrally. A standard approach for simulating travel times is the 'travelling salesman' methodology, which provides an estimate of the minimum travel time within small areas (MSOAs) based on the road network rather than distance as the crow flies.

56. There are a number of available software packages which include 'travelling salesman' algorithms. Combined with data on the number of children by age in each very small area (ONS Output Areas), a number of assumptions are required to run the 'travelling salesman' model. These include the proportion of time spent in clinics versus home visits, duration of contact time with families, and average speeds for different types of roads.

57. The method of estimation is in Annex X [to be drafted]

58. [Note - conclusion on including travel time to be drafted after discussion at ACRA's 22 July meeting.]

Market Forces Factor

59. ACRA recommended that the MFF to take account of unavoidable costs due to location continues to be applied to the whole of the public health formula, including the new component for children's 0-5 public health services.

60. The MFF is that used in NHS allocations to Clinical Commissioning Groups, which has been mapped to Local Authorities. This was preferred by ACRA to the Area Costs Adjustment in the Local Government formula as it should be updated more frequently.

The overall formula

61. Following the schematic in Figure 1, Table 3 shows each Local Authority's share of the weighted population implied by ACRA's interim recommendations and the share per 100,000 population for:

    a. for the current formula updated for data updates, the inclusion of the new formulae for substance misuse and sexual health services components[2], and the 16 groups for the SMR<75;

    b. as in (a) plus the inclusion of the component for public health services for children under the age of 5; and

    c. for comparison purposes, the current 2014-15 formula.

62. The data updates to the current formula include the latest available data for population, the SMR<75, the MFF, and age-gender weights.

63. [NB The shares in Table 3 are currently based on;

    - 16 MSOA groups for the SMR<75, with the weight per head ranging from 1 to 9.4;

    - child poverty as the measure of need for public health services for children aged under 5, with a weighting of 3 : 1 for children in and not in poverty;

    - the inclusion of an adjustment for sparsity based on Annex B6, with a 45 minutes contact time and 48% of health visitor appointments being home based and 52% clinic based;

    - the substance misuse and sexual health services need per head for the Isles of Scilly and the City of London have been taken to be the same as Cornwall and Westminster respectively.

[2] The age-gender weights for substance misuse and sexual health services have been removed from the SMR<75 based formula for the component of the overall new formula based on the SMR<75

Table 3 : Shares by Local Authority

	Current formula		Updated current plus substance misuse and sexual health and 16 SMR groups		Updated current plus substance misuse and sexual health and 16 SMR groups and <5s	
	Share of weighted population	Share of weighted population per 100,000 population	Share of weighted population	Share of weighted population per 100,000 population	Share of weighted population	Share of weighted population per 100,000 population
Hartlepool	0.25%	0.27%	0.29%	0.31%	0.26%	0.28%
Middlesbrough	0.43%	0.31%	0.54%	0.38%	0.48%	0.35%
Redcar and Cleveland	0.27%	0.20%	0.27%	0.20%	0.26%	0.19%
Stockton-on-Tees	0.43%	0.22%	0.45%	0.23%	0.43%	0.22%
Darlington	0.23%	0.22%	0.23%	0.21%	0.21%	0.20%
County Durham	0.95%	0.18%	0.97%	0.19%	0.93%	0.18%
Northumberland	0.48%	0.15%	0.49%	0.15%	0.48%	0.15%
Gateshead	0.46%	0.23%	0.49%	0.24%	0.45%	0.22%
Newcastle upon Tyne	0.76%	0.26%	0.75%	0.26%	0.69%	0.24%
North Tyneside	0.41%	0.20%	0.39%	0.19%	0.37%	0.18%
South Tyneside	0.32%	0.21%	0.32%	0.21%	0.30%	0.20%
Sunderland	0.61%	0.22%	0.57%	0.21%	0.54%	0.20%
Halton	0.32%	0.26%	0.30%	0.24%	0.28%	0.22%
Warrington	0.39%	0.19%	0.38%	0.18%	0.37%	0.18%
Blackburn with Darwen	0.44%	0.29%	0.39%	0.26%	0.37%	0.25%
Blackpool	0.42%	0.30%	0.43%	0.31%	0.39%	0.28%
Cheshire East	0.54%	0.14%	0.54%	0.14%	0.53%	0.14%
Cheshire West and Chester	0.52%	0.16%	0.57%	0.17%	0.55%	0.16%
Bolton	0.71%	0.25%	0.72%	0.25%	0.68%	0.24%
Bury	0.36%	0.19%	0.37%	0.19%	0.36%	0.19%
Manchester	1.93%	0.37%	1.73%	0.33%	1.61%	0.31%
Oldham	0.61%	0.26%	0.49%	0.21%	0.49%	0.21%
Rochdale	0.56%	0.26%	0.50%	0.23%	0.48%	0.23%
Salford	0.72%	0.29%	0.69%	0.28%	0.65%	0.26%
Stockport	0.48%	0.17%	0.49%	0.17%	0.48%	0.17%
Tameside	0.56%	0.25%	0.48%	0.21%	0.46%	0.21%
Trafford	0.38%	0.16%	0.34%	0.15%	0.35%	0.15%
Wigan	0.71%	0.22%	0.68%	0.21%	0.65%	0.20%
Knowsley	0.41%	0.28%	0.34%	0.23%	0.33%	0.23%
Liverpool	1.55%	0.33%	1.44%	0.30%	1.31%	0.28%
St. Helens	0.38%	0.21%	0.37%	0.21%	0.36%	0.20%
Sefton	0.54%	0.20%	0.56%	0.20%	0.52%	0.19%
Wirral	0.74%	0.23%	0.80%	0.25%	0.74%	0.23%
Cumbria	0.80%	0.16%	0.85%	0.17%	0.80%	0.16%
Lancashire	2.25%	0.19%	2.23%	0.19%	2.13%	0.18%
Kingston upon Hull, City of	0.73%	0.28%	0.78%	0.30%	0.72%	0.28%
East Riding of Yorkshire	0.42%	0.12%	0.40%	0.12%	0.41%	0.12%
North East Lincolnshire	0.36%	0.23%	0.39%	0.25%	0.37%	0.23%
North Lincolnshire	0.32%	0.19%	0.32%	0.19%	0.31%	0.18%
York	0.32%	0.15%	0.36%	0.18%	0.34%	0.16%
Barnsley	0.54%	0.22%	0.52%	0.22%	0.50%	0.21%
Doncaster	0.66%	0.22%	0.67%	0.22%	0.64%	0.21%
Rotherham	0.52%	0.20%	0.56%	0.21%	0.53%	0.20%
Sheffield	1.16%	0.20%	1.03%	0.18%	1.02%	0.18%
Bradford	1.33%	0.25%	1.35%	0.25%	1.31%	0.24%
Calderdale	0.41%	0.19%	0.40%	0.19%	0.39%	0.19%

	Current formula		Updated current plus substance misuse and sexual health and 16 SMR groups		Updated current plus substance misuse and sexual health and 16 SMR groups and <5s	
	Share of weighted population	Share of weighted population per 100,000 population	Share of weighted population	Share of weighted population per 100,000 population	Share of weighted population	Share of weighted population per 100,000 population
Kirklees	0.89%	0.20%	0.89%	0.20%	0.86%	0.20%
Leeds	1.69%	0.22%	1.88%	0.24%	1.77%	0.23%
Wakefield	0.72%	0.22%	0.72%	0.22%	0.68%	0.20%
North Yorkshire	0.74%	0.12%	0.76%	0.13%	0.77%	0.13%
Derby	0.61%	0.23%	0.63%	0.25%	0.60%	0.23%
Leicester	0.93%	0.27%	0.85%	0.25%	0.83%	0.24%
Rutland	0.03%	0.09%	0.03%	0.09%	0.04%	0.10%
Nottingham	0.96%	0.30%	0.85%	0.27%	0.81%	0.26%
Derbyshire	1.15%	0.15%	1.13%	0.14%	1.13%	0.14%
Leicestershire	0.83%	0.12%	0.91%	0.13%	0.91%	0.14%
Lincolnshire	1.07%	0.15%	0.98%	0.13%	1.01%	0.14%
Northamptonshire	1.16%	0.16%	1.13%	0.16%	1.16%	0.16%
Nottinghamshire	1.30%	0.16%	1.33%	0.16%	1.30%	0.16%
Herefordshire, County of	0.25%	0.13%	0.28%	0.15%	0.27%	0.14%
Telford and Wrekin	0.32%	0.19%	0.33%	0.19%	0.32%	0.19%
Stoke-on-Trent	0.65%	0.26%	0.70%	0.28%	0.66%	0.26%
Shropshire	0.39%	0.12%	0.42%	0.13%	0.41%	0.13%
Birmingham	2.93%	0.26%	2.86%	0.26%	2.82%	0.25%
Coventry	0.83%	0.24%	0.78%	0.23%	0.76%	0.22%
Dudley	0.53%	0.17%	0.54%	0.17%	0.53%	0.17%
Sandwell	0.82%	0.26%	0.72%	0.22%	0.73%	0.23%
Solihull	0.30%	0.14%	0.32%	0.15%	0.32%	0.15%
Walsall	0.60%	0.22%	0.57%	0.21%	0.57%	0.21%
Wolverhampton	0.61%	0.24%	0.55%	0.22%	0.55%	0.22%
Staffordshire	1.25%	0.15%	1.19%	0.14%	1.18%	0.14%
Warwickshire	0.79%	0.14%	0.77%	0.14%	0.78%	0.14%
Worcestershire	0.77%	0.13%	0.77%	0.13%	0.78%	0.14%
Peterborough	0.42%	0.21%	0.43%	0.22%	0.43%	0.22%
Luton	0.54%	0.25%	0.47%	0.22%	0.49%	0.23%
Southend-on-Sea	0.33%	0.18%	0.34%	0.19%	0.34%	0.19%
Thurrock	0.28%	0.17%	0.27%	0.16%	0.30%	0.18%
Bedford	0.29%	0.17%	0.33%	0.20%	0.33%	0.20%
Central Bedfordshire	0.37%	0.13%	0.36%	0.13%	0.39%	0.14%
Cambridgeshire	0.84%	0.13%	0.88%	0.14%	0.91%	0.14%
Essex	1.89%	0.13%	1.94%	0.13%	2.06%	0.14%
Hertfordshire	1.62%	0.14%	1.69%	0.14%	1.82%	0.15%
Norfolk	1.13%	0.13%	1.17%	0.13%	1.20%	0.14%
Suffolk	0.87%	0.12%	0.91%	0.12%	0.96%	0.13%
Barking and Dagenham	0.55%	0.26%	0.50%	0.24%	0.55%	0.27%
Barnet	0.54%	0.14%	0.60%	0.16%	0.67%	0.17%
Bexley	0.36%	0.15%	0.35%	0.14%	0.39%	0.16%
Brent	0.67%	0.21%	0.63%	0.19%	0.68%	0.21%
Bromley	0.42%	0.13%	0.45%	0.14%	0.50%	0.15%
Camden	0.66%	0.28%	0.63%	0.26%	0.60%	0.25%
Croydon	0.69%	0.18%	0.76%	0.20%	0.81%	0.21%
Ealing	0.74%	0.21%	0.74%	0.21%	0.77%	0.22%
Enfield	0.59%	0.18%	0.66%	0.20%	0.73%	0.22%

	Current formula		Updated current plus substance misuse and sexual health and 16 SMR groups		Updated current plus substance misuse and sexual health and 16 SMR groups and <5s	
	Share of weighted population	Share of weighted population per 100,000 population	Share of weighted population	Share of weighted population per 100,000 population	Share of weighted population	Share of weighted population per 100,000 population
Greenwich	0.72%	0.26%	0.60%	0.22%	0.64%	0.24%
Hackney	0.83%	0.31%	0.85%	0.32%	0.83%	0.31%
Hammersmith and Fulham	0.43%	0.24%	0.45%	0.25%	0.44%	0.25%
Haringey	0.69%	0.25%	0.68%	0.25%	0.68%	0.25%
Harrow	0.34%	0.14%	0.36%	0.14%	0.41%	0.16%
Havering	0.39%	0.15%	0.37%	0.15%	0.40%	0.16%
Hillingdon	0.57%	0.19%	0.53%	0.18%	0.58%	0.19%
Hounslow	0.57%	0.21%	0.54%	0.20%	0.58%	0.21%
Islington	0.74%	0.33%	0.73%	0.32%	0.68%	0.30%
Kensington and Chelsea	0.26%	0.17%	0.35%	0.23%	0.34%	0.22%
Kingston upon Thames	0.25%	0.15%	0.25%	0.15%	0.28%	0.16%
Lambeth	1.00%	0.31%	0.97%	0.30%	0.93%	0.29%
Lewisham	0.73%	0.24%	0.77%	0.26%	0.79%	0.27%
Merton	0.31%	0.15%	0.33%	0.16%	0.37%	0.18%
Newham	1.05%	0.31%	0.85%	0.25%	0.90%	0.27%
Redbridge	0.50%	0.16%	0.48%	0.16%	0.55%	0.18%
Richmond upon Thames	0.24%	0.12%	0.27%	0.14%	0.30%	0.15%
Southwark	0.87%	0.28%	0.93%	0.30%	0.91%	0.29%
Sutton	0.32%	0.16%	0.31%	0.15%	0.34%	0.17%
Tower Hamlets	0.99%	0.34%	0.93%	0.32%	0.93%	0.32%
Waltham Forest	0.66%	0.24%	0.55%	0.20%	0.61%	0.22%
Wandsworth	0.69%	0.21%	0.69%	0.22%	0.71%	0.22%
Westminster	0.49%	0.21%	0.61%	0.26%	0.59%	0.25%
Medway	0.54%	0.20%	0.53%	0.19%	0.53%	0.19%
Bracknell Forest	0.17%	0.14%	0.18%	0.15%	0.19%	0.16%
West Berkshire	0.20%	0.13%	0.19%	0.12%	0.21%	0.13%
Reading	0.38%	0.24%	0.37%	0.23%	0.37%	0.23%
Slough	0.34%	0.23%	0.33%	0.22%	0.35%	0.23%
Windsor and Maidenhead	0.20%	0.14%	0.21%	0.14%	0.22%	0.14%
Wokingham	0.17%	0.11%	0.18%	0.11%	0.20%	0.12%
Milton Keynes	0.46%	0.17%	0.45%	0.17%	0.49%	0.18%
Brighton and Hove	0.69%	0.24%	0.73%	0.26%	0.65%	0.23%
Portsmouth	0.51%	0.24%	0.51%	0.24%	0.48%	0.23%
Southampton	0.57%	0.23%	0.56%	0.23%	0.54%	0.22%
Isle of Wight	0.18%	0.13%	0.20%	0.14%	0.20%	0.14%
Buckinghamshire	0.68%	0.13%	0.65%	0.12%	0.70%	0.13%
East Sussex	0.69%	0.13%	0.79%	0.15%	0.79%	0.15%
Hampshire	1.62%	0.12%	1.63%	0.12%	1.74%	0.13%
Kent	2.19%	0.14%	2.11%	0.14%	2.24%	0.15%
Oxfordshire	0.98%	0.15%	0.99%	0.15%	1.02%	0.15%
Surrey	1.45%	0.12%	1.44%	0.12%	1.58%	0.13%
West Sussex	1.02%	0.12%	1.08%	0.13%	1.12%	0.13%
Bath and North East Somerset	0.26%	0.14%	0.31%	0.17%	0.29%	0.16%
Bristol, City of	1.10%	0.24%	1.13%	0.25%	1.08%	0.24%
North Somerset	0.29%	0.13%	0.32%	0.15%	0.32%	0.15%
South Gloucestershire	0.33%	0.12%	0.33%	0.12%	0.35%	0.13%
Plymouth	0.55%	0.21%	0.63%	0.24%	0.58%	0.22%

	Current formula		Updated current plus substance misuse and sexual health and 16 SMR groups		Updated current plus substance misuse and sexual health and 16 SMR groups and <5s	
	Share of weighted population	Share of weighted population per 100,000 population	Share of weighted population	Share of weighted population per 100,000 population	Share of weighted population	Share of weighted population per 100,000 population
Torbay	0.20%	0.15%	0.25%	0.19%	0.24%	0.18%
Bournemouth	0.40%	0.21%	0.42%	0.22%	0.39%	0.20%
Poole	0.19%	0.13%	0.20%	0.13%	0.21%	0.14%
Swindon	0.38%	0.17%	0.37%	0.16%	0.38%	0.17%
Cornwall	0.67%	0.12%	0.79%	0.14%	0.79%	0.14%
Wiltshire	0.56%	0.12%	0.57%	0.12%	0.61%	0.13%
Devon	0.83%	0.11%	0.91%	0.12%	0.94%	0.12%
Dorset	0.44%	0.11%	0.49%	0.12%	0.49%	0.12%
Gloucestershire	0.82%	0.13%	0.80%	0.13%	0.83%	0.13%
Somerset	0.63%	0.12%	0.66%	0.12%	0.69%	0.13%
City of London	0.01%	0.11%	0.02%	0.26%	0.02%	0.22%
Isles of Scilly	0.00%	0.10%	0.00%	0.14%	0.00%	0.13%

ANNEX B: RESPONSE TO QUESTIONS RAISED BY ACRA AT APRIL MEETING

1. Formula for Local Authorities' current responsibilities

1.1 Secretariat to provide details on components of change in SMR<75 between the number of deaths and the population denominator, in the current model with data updates

See Annex B1

1.2 Secretariat to produce 2 alternatives for summer engagement. The first with 17 SMR bandings (at least 30 MSOAs per band) and the second a continuous weighting across each SMR<75

See Annex B2

1.3 The secretariat to circulate the explanation of why, in the sexual health formula, the R-squared is lower at local authority level when high cost patients are excluded compared with when they are included.

While the formula performs better at the individual level when high cost patients are excluded, this narrower formula is less representative of total local authorities' expenditure and therefore performs less well at local authority level.

1.4 Secretariat to investigate further the differences between actual and modelled SMR at local authority level

The current formula is largely based on the SMR<75 at MSOA level. The research team presented to ACRA earlier this year the predicted or modelled SMR<75s at MSOA level.

The potential advantages of modelled SMR<75s are that they should remove the random component of the actual SMR<75. In addition, if an area has a high performing public health system that reduces the SMR<75 in its area, its future allocations will be lower even if it needs the original allocations to maintain the lower SMR<75 as it still faces the same poor underlying determinants.

The explanatory variables included in the model were IMD income score, % in professional/scientific occupations, % leaving education, % families receiving working time credits, % receiving Job Seekers Allowance, % homes without central heating, % occupied homes with fewer than two bedrooms, air pollution, county court judgements and PCT dummy variables (the SMR<75 data are for 2008-12, when PCTs were responsible for commissioning public health).

As discussed at the last ACRA meeting, there were unexplained regional differences between predicted and actual SMR<75, with:

- the predicted was higher than actual in London and parts of East Anglia and the South West; and

- the predicted was lower than actual in the North West, parts of the North East, and parts of Yorkshire.

The researchers conclusions on the regional pattern are:

"There are two possible explanations for these systematic patterns. The first is that the historic efforts of public health bodies have led to better than expected outcomes in London and worse than expected outcomes in the North, even accounting for a rich set of risk factors for poor health. The second is that there are needs-related causes of poor health that are omitted from the datasets that we have been able to source for this analysis. Our assessment is that the second explanation is more likely. This would tend to the decision to use the observed values of the SMR for allocating funds for population health rather than modelled values until models that avoid this systematic pattern are identified."

Rob Shaw has identified high correlation between the PCT dummies and air quality and managed to remove most of the regional pattern by removing the air quality variable from the model.

It is recommended that a predicted SMR<75 is not adopted at this point because:

- the SMR<75 was chosen for the population health measure as it is regularly updated. The modelled SMR<75 cannot be easily updated as it uses data from the Census and IMD;

- We do not have an agreed model for predicted SMR<75 and the researchers do not recommend their model.

2. Formula for 0-5 children's public heath

2.1 Secretariat to provide more information on engagement responses. For example geographic spread, ONS cluster and GOR region

See Annex B3

2.2 Secretariat, with assistance from ONS, to investigate level of population churn using ONS data. For example what is the range of churn between local authorities?

See Annex B4

2.3 Secretariat to investigate the Child Health Information System and "problem" families as possible data sources on population churn

We have been informed that not all the Child Health Information Systems for different Child Health Information services are connected, and there would need to be connectivity between CHIS and the GP practice to validate the movers in and out – therefore we cannot at this stage confirm that all movers in and movers out can be

identified via CHIS – however, NHS England is in the process of implementing a new service for primary care services (formally FHS), with the expectation that a movers in and out report will be made available for the Child Information services

2.4 Secretariat to investigate if data are available on the distribution of family income, for example how many are just above the 60% threshold used in the definition of child poverty

While there are data on the national distribution of taxable income by individual, and estimates of household income, person, we are not found any data on the distribution of income of families with children by Local Authority.

2.5 Secretariat to explore further potential need variables

We have not identified additional good measures of need. Rob Shaw has undertaken some exploratory work taking combining a number of measures. He has used principal components analysis to try to uncover patterns between Income Deprivation Affecting Children 2010, IMD2010, children in need, children over support from social services, children in need of a child protection plan, child poverty (2008-12), low birth weight term births (2008-12) and infant mortality (2007-12) and avoidable SMR<75.

The table below shows the first two components and the rotated loadings for the variables. These strongly cluster into two groups, with CIN and CP clearly separate from the others that form component 1.

Variable	Comp1	Comp2	Unexplain
----------+----------+----------			
idac2010	0.412	-0.1105	0.23
imd2010	0.4304	0.0833	0.07566
cinage142014	0.0641	0.6571	0.1905
cpage142014	-0.0541	0.7142	0.1508
childpo~0812	0.4333	-0.0216	0.1252
lbwbterm0812	0.4092	-0.1254	0.2411
infantm~0712	0.3611	0.024	0.3752
smravoid75	0.3905	0.1491	0.1787

These loadings can then be used to create weights as the beginning of the basis for weights per head.

2.6 Secretariat to outline impact of differences between alternative child poverty weights

See Annex B5.

2. 7 Secretariat to seek further expert opinion regarding local service provision, the split between universal and additional support and rationale behind the 3:1 gearing

The further advice we have received on the 3:1 ratio is that there is no explicit mapping or recommendations on number of visits and/or models of service provision, and it is a judgement.

Paul Edmondson-Jones at the April ACRA meeting advised that a ratio of 3 : 1 seemed about right for current service provision, but 5 : 1 would be more appropriate to support the Marmot challenge.

A simple regression of budgets for the second half of 2015-16 against the proportion of children in poverty suggests ratio of around 4.3 : 1 for a child in and not in poverty. However, the R^2 is only 25%.

Budgets for the second half of 2015-16 by Local Authority were principally based on a lift and shift of spend by area by NHS England.

2.7 Rob Shaw to develop further the travelling salesman model to incorporate LA average speeds, average height of dwelling and public transport

See Annex B6

Annex B1 : Components of change in SMR<75 between the number of deaths and the population denominator, in the current model with data updates.

Background

1. At the April ACRA meeting the results of updating the current public health formula (for 2016-17 with latest available data) were presented along with comparisons of how Local Authority overall weighted populations have changed from those used for the 2014-15 public health allocations.

2. This showed that the change in overall weighted populations ranged from an increase of 13.1% to a decrease of -13.7%, with the largest decreases appearing to be driven by falls in the SMR<75.

3. ACRA noted that the SMR<75 has declined most in some of the more deprived areas. One potential explanation is that it appears to be due to changes in the population estimates used to calculate the SMR<75. Should there be increases in population (denominator) then the SMR<75 will decrease for a given number of deaths.

SMR<75 methodology

4. For the 2016-17 update: The numerator is the number of deaths for all persons aged under 75 in the calendar years 2008-2012.

   The denominator is the number of expected deaths calculated by applying age-specific death rates for England in 2008-12 to each area's mid-year population estimates for the same period.

5. For the 2014-15 public health formula the SMR<75 used was calculated using deaths and populations for the period 2006-2010. This is before the results of the 2011 population census were published, which showed some large revisions to many areas' populations from the mid-year estimates in the years running up to 2011.

Analysis

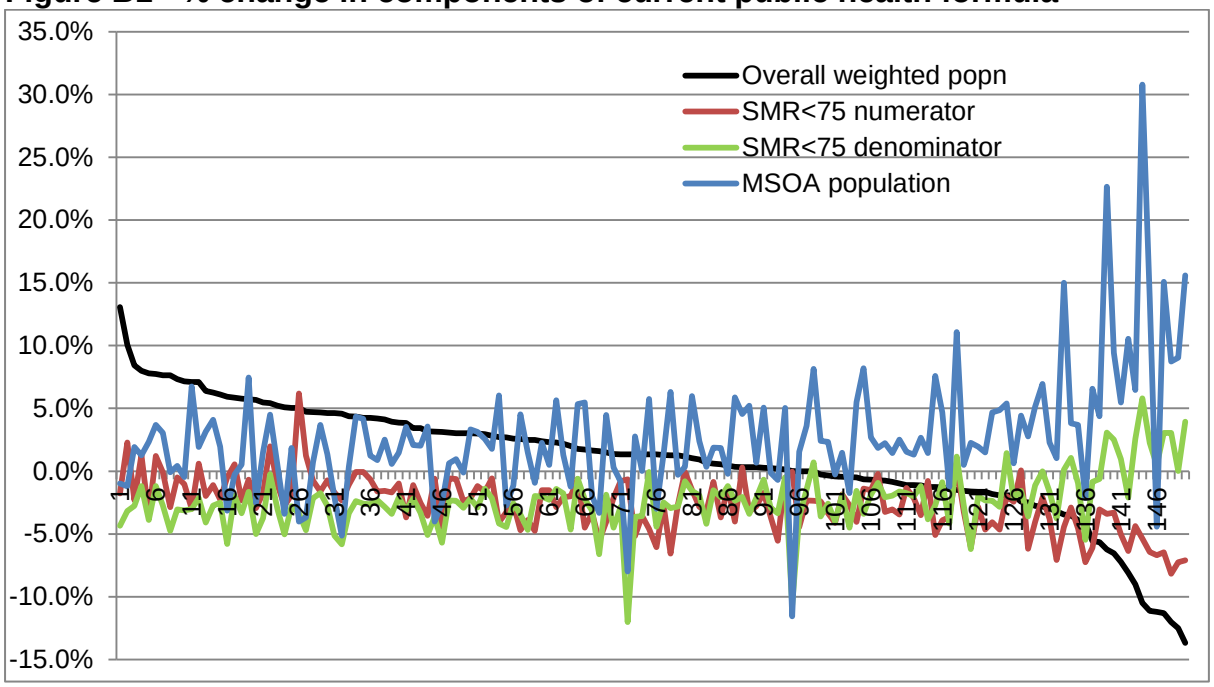
6. The change in the numerator and denominator for the SMR<75 was calculated at LA level (by aggregating from MSOA to LA). The 5-year populations used to calculate the expected deaths are not available.

7. The change in the MSOA populations[3] applied to the SMR<75 weights in the public health formula was also calculated at LA level

8. These are given in Figure 1 along with the change in the overall weighted populations for LAs from 2014-15 to 2016-17.

[3] Mid-2010 MSOA population estimates (based on the 2001 Census) were used in the 2014-15 public health formula. Mid-2012 MSOA estimates (based on the 2011 Census) were used in the 2016-17 public health formula update.

Figure B1 - % change in components of current public health formula



9. It can be seen that LAs with the largest decrease in their overall weighted population tend to have large increases in their MSOA populations which also leads to increases in their SMR<75 denominators (expected deaths). They also see a decrease in their SMR<75 numerators (observed deaths), therefore a lower numerator and higher denominator combine to decrease their SMR<75 which in turn decreases their overall weighted population.

10. For LAs with the largest increases in their overall weighted population the opposite is true in that their SMR<75 numerators have increased or remained stable whilst their SMR<75 denominators have decreased. Therefore their SMR<75 has increased which in turn has increased their overall weighted population.

11. The percentage changes for the ten LAs with the largest decrease in their overall weighted population are given in Table 1. Nine of the ten LAs are in London.

Table B1 – LAs with the largest decrease in overall weighted population

	Overall weighted population	SMR<75 numerator	SMR<75 denominator	MSOA population
Waltham Forest	-13.7%	-7.1%	3.9%	15.6%
Lambeth	-12.5%	-7.3%	0.0%	9.0%
Islington	-12.0%	-8.2%	3.0%	8.7%
Haringey	-11.3%	-6.5%	3.0%	15.1%
Camden	-11.2%	-6.7%	0.5%	-4.4%
Greenwich	-11.1%	-6.4%	2.3%	13.8%
Newham	-10.5%	-5.4%	5.8%	30.8%
Wandsworth	-9.0%	-4.4%	2.6%	6.5%
Tower Hamlets	-8.1%	-6.4%	-2.1%	10.6%
Blackburn with Darwen	-7.2%	-5.0%	1.0%	5.5%

Annex B2 : Secretariat to produce 2 alternatives for summer engagement. The first with 17 SMR bandings (at least 30 MSOAs per band) and the second a continuous weighting across each SMR<75

Table B2.1 shows the grouping of MSOAs by SMR<75 as in the current formula on the left hand side. Each MSOA was assigned to one of ten groups based on the value of their SMR<75. MSOAs in the same group were given the same weight per head. MSOAs in the group with the highest SMR<75s were given a weight per head 5 times higher than the MSOAs in the group with the lowest SMR<75s. The weight per head for the intermediate group increased exponentially.

It was intended that the each group would be equal width in terms of the range of SMR<75 they covered. However, ACRA applied a rule that none of the ten groups should contain fewer than 5% of the total number of MSOAs. This was intended to reduce the impact of random fluctuations in the SMR<75 over time and remove the effect of outliers which may be due to data issues. The condition that none of the ten groups should contain fewer than 5% of the total number of MSOAs meant the two groups with the lowest and highest MSOAs each covered a wide range of SMR<75s.

At its April meeting, ACRA preferred a new set of groups with a more similar span of SMR<75, and an example of 20 equal width shown on the right hand side of Table B2.1 which was discussed at the April ACRA meeting. ACRA decided to impose a restriction that no group should contain fewer than 30 MSOAs.

Table B2.1 : Grouping of MSOAs by SMR<75

Current groups				**Alternative groups**				
Group	% of MSO	SMR<75 width		Group	No of MSOAs	% of MSOAs	SMR<75 width	
1	5%	36.8	61.9	1	30	0.4%	36.8	48.9
2	14%	61.9	74.3	2	261	3.8%	48.9	60.9
3	19%	74.3	86.6	3	884	13.0%	60.9	73.0
4	17%	86.6	99.0	4	1212	17.8%	73.0	85.0
5	12%	99.0	111.4	5	1115	16.4%	85.0	97.1
6	10%	111.4	123.8	6	857	12.6%	97.1	109.1
7	8%	123.8	136.1	7	707	10.4%	109.1	121.2
8	6%	136.1	148.5	8	544	8.0%	121.2	133.2
9	5%	148.5	165.6	9	398	5.9%	133.2	145.3
10	5%	165.6	277.8	10	315	4.6%	145.3	157.3
				11	188	2.8%	157.3	169.4
				12	104	1.5%	169.4	181.4
				13	65	1.0%	181.4	193.5
				14	40	0.6%	193.5	205.5
				15	29	0.4%	205.5	217.6
				16	26	0.4%	217.6	229.6
				17	7	0.1%	229.6	241.7
				18	7	0.1%	241.7	253.7
				19	1	0.0%	253.7	265.8
				20	1	0.0%	265.8	277.8

To achieve this criterion we

- left groups 1 to 13 unchanged from the right hand side of the table above
- combined the 30 MSOAs with the highest SMR<75 into one group (new group 16)
- the remaining MSOAs were divided between new groups 14 and 15 so that they both had the same SMR<75 span.

The result is shown in Table B2.2

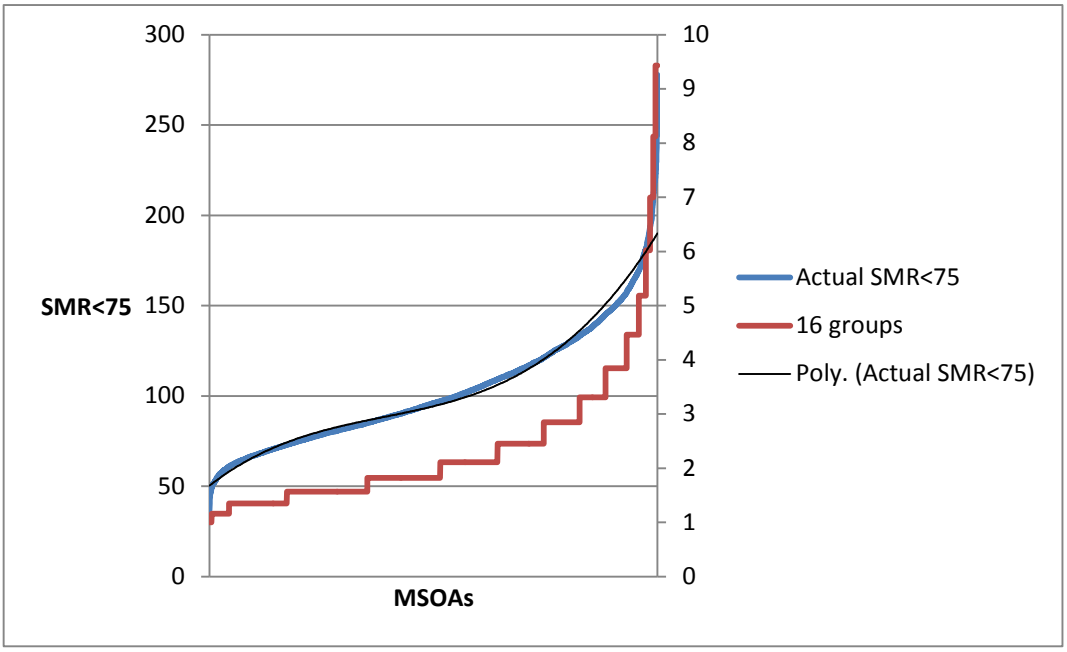
Table B2.2 : Proposed revised grouping of MSOAs by SMR<75

Alternative 16 groups						
Group	of MSOAs	of MSOAs	SMR<75	width	SMR span	Weight per head
1	30	0.4%	36.8	48.9	12.1	1.00
2	261	3.8%	48.9	60.9	12.1	1.16
3	884	13.0%	60.9	73.0	12.1	1.35
4	1212	17.8%	73.0	85.0	12.1	1.57
5	1115	16.4%	85.0	97.1	12.1	1.82
6	857	12.6%	97.1	109.1	12.1	2.11
7	707	10.4%	109.1	121.2	12.1	2.45
8	544	8.0%	121.2	133.2	12.1	2.85
9	398	5.9%	133.2	145.3	12.1	3.31
10	315	4.6%	145.3	157.3	12.1	3.84
11	188	2.8%	157.3	169.4	12.1	4.46
12	104	1.5%	169.4	181.4	12.1	5.18
13	65	1.0%	181.4	193.5	12.1	6.02
14	45	0.7%	193.5	207.9	14.4	6.99
15	36	0.5%	207.9	222.3	14.5	8.12
16	30	0.4%	222.3	277.8	55.5	9.43

To produce weights per head for the new 16 groups, we maintained the ratio of 5 : 1 between the SMR<75 of the medians of the former groups 10 and 1, and extrapolated this to all16 groups using a simple exponential curve. This gave the weights per head in the final column of Table B2.2, and extended the range from 5 : 1 for the former 10 groups to 9.43 : 1 for the 16 groups.

We sought to apply an exponential curve across the SMR<75 with no grouping, but no simple exponential curve reached a SMR<75 as high as the median of the former 10^{th} group of 10 (we tried up to the power of 4).

The chart below shows the actual SMR<65, the 16 groups with a weight per head with the range of 9.43 : 1


300
250
200
150
100
50
0
SMR<75
10
9
8
7
6
5
4
3
2
1
0
MSOAs
Actual SMR<75
16 groups
Poly. (Actual SMR<75)

Annex B3 – Respondent profile in march engagement on formula for children's 0-5 public health services

This annex provides basic details about the profile of local authority respondents in areas such as Government region and IMD decile. It also lists the other umbrella bodies who responded to the consultation.

101 Local authorities and 13 umbrella bodies responded to the consultation.

The analysis which follows should be read in the context of an engagement which was a "call for evidence" and not a voting exercise for different options. As such it has not always been possible to analyse the characteristics of different responses or why people may have answered the way they did.

Umbrella Associations

The following table lists the other umbrella organisations responded.

Association of Directors of PH
Association of North East Councils
Cheshire and Mersey Directors of PH
Family Nurse Partnerships - National Unit
Greater Manchester Directors of Public Health
Greater Manchester, Lancashire and South Cumbria Strategic Clinical Network
Institute of Health Visitors
Local Government Association
London Councils
National Children's Beareau
Royal College of Physicians
SIGOMA (Special Interest Group of Municipal Authorities)
South West Public Health Economics

These associations either contain representatives from multiple local authorities or are involved with the delivery of the 0-4 / FNP programs. It should be noted that some of the local authorities who did not submit an individual response may have contributed to one of these replies.

Government Office Region

The table below shows a breakdown by Government Office Region

NHS England Region			
	Total	Yes	No
North of England	50	34	16
Midlands and East	34	23	11
London	33	17	16
South of England	35	27	8

This shows that there was a good response throughout England with at least 50% of authorities responding in each GOR.

It is likely that some of the London councils who did not submit an individual response will have contributed to the response from “London Councils”. Equally those in the North West may well have been represented by the three umbrella bodies covering the region.

ONS Clusters

The Office for National Statistics clusters local authorities into a number of different clusters according to geography and economic conditions.

ONS Clusters	Total	Yes	No	%age
Industrial Hinterlands	17	13	4	76
Centres with Industry	17	11	6	65
Coastal and Countryside	5	4	1	80
London Centre	8	4	4	50
London Cosmopolitan	7	4	3	57
London Suburbs	12	8	4	67
Manufacturing Towns	10	5	5	50
New and Growing Towns	8	6	2	75
Prospering Smaller Towns	19	13	6	68
Prospering Southern England	4	0	4	0
Regional Centres	12	9	3	75
Thriving London Periphery	6	2	4	33
Upper tier	27	22	5	81

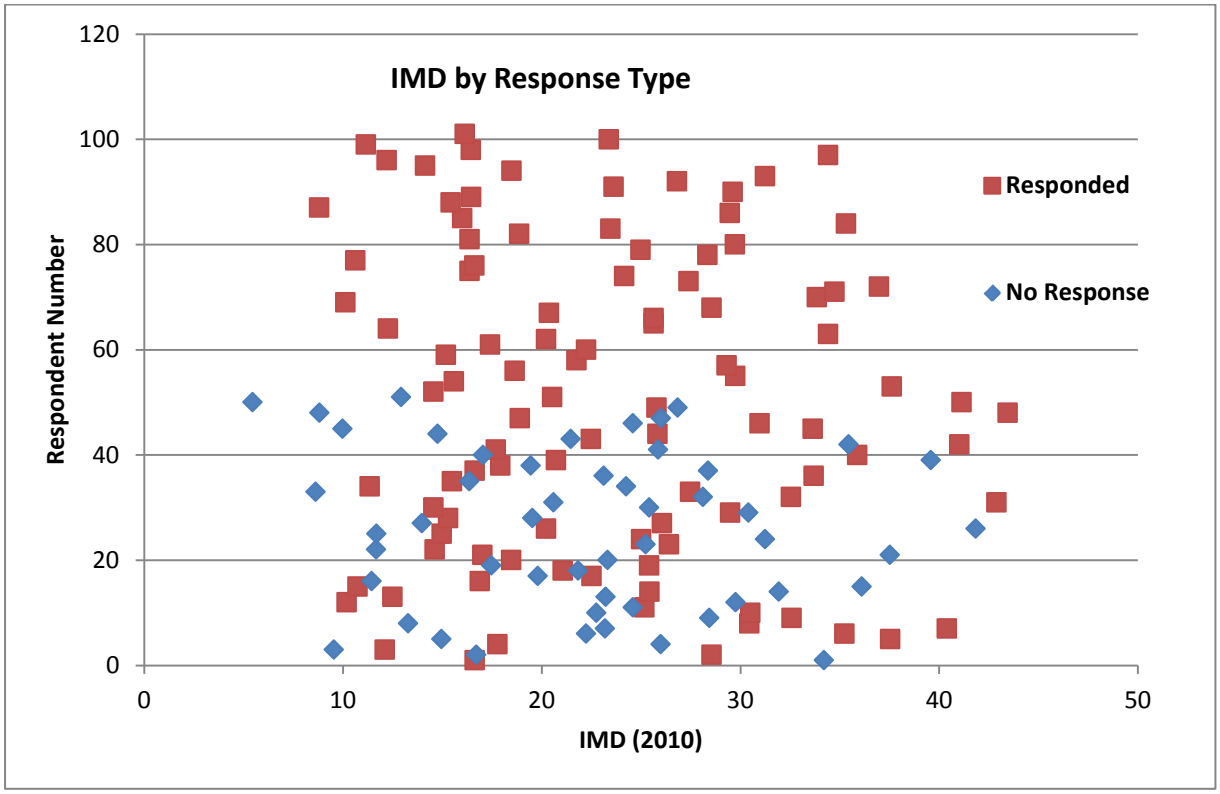
This suggests a fairly good response from most types of local authority. The exception to this was “prospering southern England” where none of the 4 authorities submitted a response.

IMD Decile

This table displays the response rate by IMD decile. In decile 1 and 6 the response rate was less than 50% however again this may be because the views have been picked up elsewhere.

Decile	IMD Min	IMD Max	LA’s	Yes	No	%age
1	5	12	15	7	8	47
2	12	15	15	10	5	67
3	15	17	15	13	2	87
4	17	20	15	11	4	73
5	20	23	16	10	6	63
6	23	25	16	7	9	44
7	25	27	15	11	4	73
8	28	30	15	10	5	67
9	31	35	15	12	3	80
10	35	43	15	10	5	67

The scatter plot above shows the IMD score for each authority and whether or not they responded to the consultation.



The scatter plot above shows the IMD score for each authority and whether or not they responded to the consultation. It shows no real relationship between IMD and response rate. The average IMD score was also very similar for the 2 groups with a slightly lower average for those who did not respond (23.5 v 22.3.)

Answers to specific questions

At the last meeting of ACRA we were asked to provide more details about how different types of authority responded to certain questions.

Any analysis of responses to specific questions must be treated with extreme caution. The “call for evidence” nature of the engagement makes it difficult to effectively analyse individual responses. The questions were “open” in nature which gave authorities the chance to provide additional information and avenues for research.

The analysis which follows makes no attempt to assess the strength of opinions presented. For example some authorities may have expressed vehement opposition to the 3:1 weighting where as others might have said that the weight was fair but in need of additional evidence.

A) Population Base

There was consensus that ONS sub national population projections should form the base of analysis.

B) Population Churn

As discussed above it was widely agreed that population churn, alongside other unavoidable costs, should be taken into account providing a robust evidence base could be found.

C) Child Poverty Weight

Approximately 45 authorities expressed a view on the weighting of 3:1 included in the engagement document. Of these around 20 were in favour of a higher gearing, 20 felt that 3:1 was about right and 5 thought that 3:1 was too strong. Of the remaining authorities most felt that more evidence was required.

Those in favour of a stronger weighting for child poverty tended to be areas with higher levels of deprivation.

IMD Decile	Stronger Weight	3:1 Suitable	Lower Weight	More Evidence Required
1	0	0	0	5
2	0	5	1	4
3	0	2	2	8
4	0	2	1	6
5	1	3	0	5
6	1	2	0	3
7	3	1	0	7
8	5	0	0	5
9	5	2	0	5
10	5	2	0	2

Those in the north of England were also more likely to be in favour of a stronger weighting compared to those in the South.

Region	Stronger Weight	3:1 Suitable	Lower Weight	More Evidence Required
North of England	15	1	1	17
Midlands and East	3	6	3	10
London	2	5	2	6
South of England	1	9	0	15

D) Market Forces Factor

Another question where there was some split between respondents was on the application of the Market Forces Factor to account for unavoidable costs. While there was general agreement that unavoidable cost should be taken into account there was some disagreement about the best way to apply any adjustment.

Around 55 authorities were in favour of adopting the MFF adjustment, 20 believed something different should be used and others who felt more evidence was required about which, if any, adjustment should be used.

Region	Support MFF	Oppose MFF	More Evidence Required
North of England	18	9	6
Midlands and East	14	5	3
London	7	1	6
South of England	16	4	3

There was support for the MFF adjustment throughout England with a majority in each of the NHS regions favouring the use of MFF.

The greatest opposition came from the North of England where one third of those who expressed a preference were opposed to MFF. Some responses felt that MFF penalises the North of England.

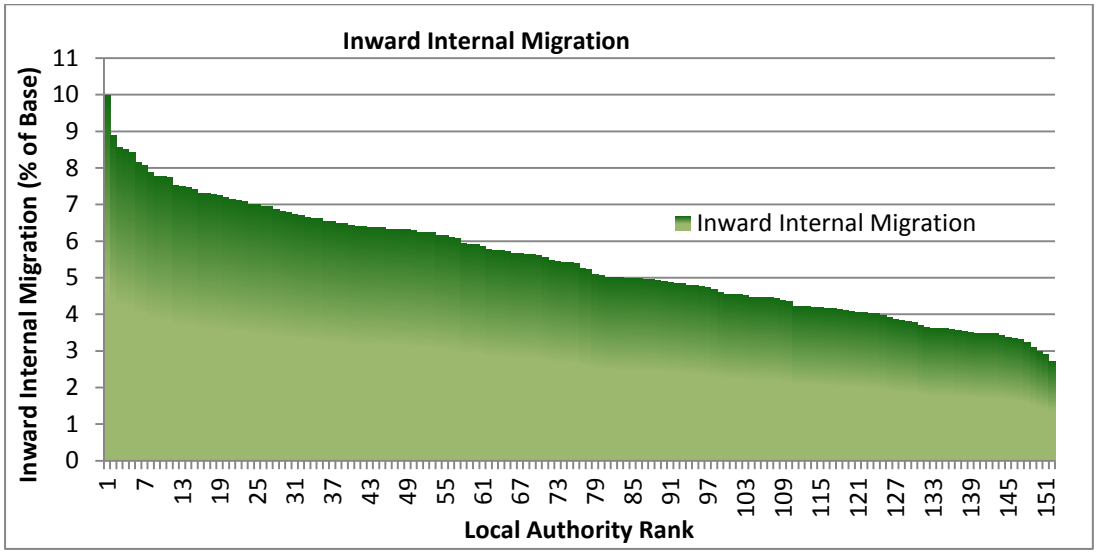
Annex B4: Population churn

At the April ACRA, during discussion of the 0-4 public health formula, the secretariat was asked to investigate population inflow for differences between regions and types of people movement. The suggestion being that areas of high population turnover would experience significantly higher costs due to both processing new arrivals as well as the suggestion this group may have greater, more costly, needs.

With thanks to Steve Smallwood introductory analysis has been undertaken on 2012 sub national population projections. Figures for internal and international migration were separated on the basis, suggested by ACRA, that these groups impose significantly different costs. This analysis focused on those in the 0-4 age group.

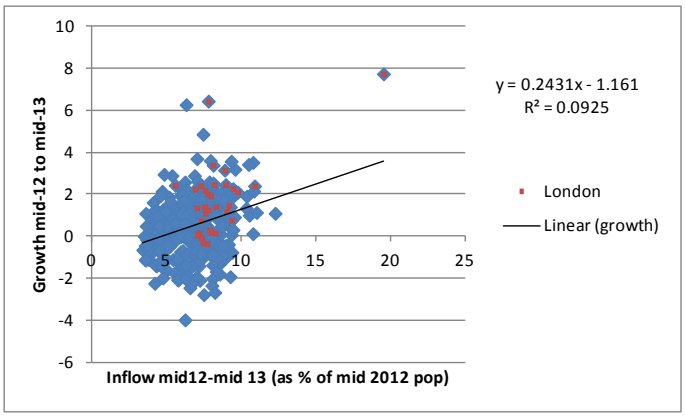
The key results of this analysis are:

1) The data suggests differences between local authorities in terms of both internal and international inflow. The chart below shows inward internal migration as a proportion of the 0-4 population.



2) Internal migration was estimated to be much larger than international migration. Outside of London it was rare to see more than 1% international inflow. ACRA suggested that international migrants should be treated differently however it may be the case that those areas with large numbers of international migrants, in particular around London, are well equipped to deal with internationals and have well developed systems in place. Costs may increase should these people move again but it is impractical to track individuals.

3) A need has been recognised to look beyond turnover figures alone. The proposed formula will use ONS population estimates which may take into account migration. Using 2012-13 estimates there is however not a particularly high correlation between inflow and population growth. This may be expected as all areas will experience outflow as well as inflow.



4) Further ideas were suggested that it may not be the act of migration which causes additional costs but rather the family situation of the child. For example any mother without English as a first language may impose the additional costs discussed by ACRA surrounding things such as translation services. It may also be the case that first children are more costly, beyond the funding supplied through Family Nurse Partnerships, as these parents may require additional support for a first pregnancy.

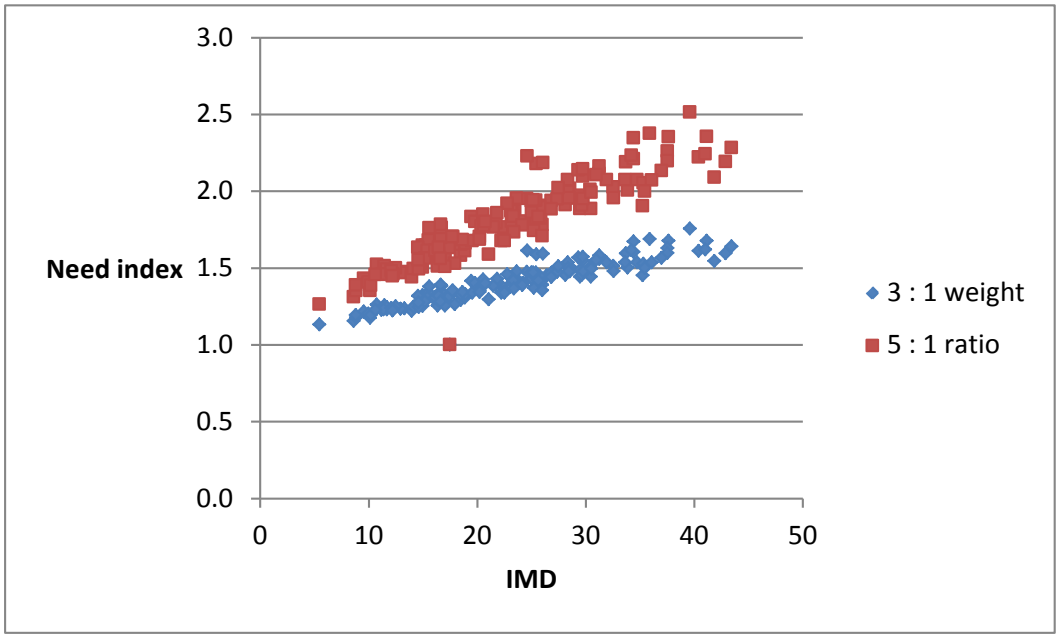
5) We are lacking, quantified, costs associated with inflow and the proportion of these costs in terms of the service as a whole. The current data suggests that around 90% of the population is unchanged from year to year and therefore more evidence would be required to warrant any adjustment.

Conclusion

Given the current evidence we are therefore inclined to recommend against an adjustment being made for population churn. This is because movers comprise a relatively small proportion of the overall population, we are lacking evidence on the extent of additional costs and if an adjustment for turnover was included there would be an argument to make other adjustments based on factors such as demographics and birth order.

Annex B5 : Impact of alternative weights per head for child poverty

The chart below shows the increase in the need per head (no MFF and no adjustment for sparsity) for a weight per head per child in poverty of 3 compared with a weight on 1 for a child not in poverty, and also with a ratio of 5 to 1 for a child in and not in poverty. The horizontal axis is IMD2010 with deprivation increasing from left to right.



Annex B6 : Travelling salesman modelling for health visitor home visits - updated

1. This note summarises analysis to model the relative time taken likely to be required by health visitors undertaking home visits in difference parts of England. It updates previous analysis and now:

    - Uses the more detail Mastermap ITN product from Ordnance Survey as the basis for the road network

    - Uses modelled actual road speeds for individual roads based on data from the Highways Agency for trunk roads and data collected from LAs by the Department of Transport for local A roads. Speeds for other roads are modelled based on the average speeds that are available.

    - Adjusts travel time for multi-storey building using data from Ordnance Survey on building heights.

Methodology

Target population

2. The lowest geographical level available for data on the population of children by single year of age is Output Area (OA) from the 2011 census. The total number of 2011 OAs is 171,372 in England and they have an average population of 309 people.

3. For this analysis we are interested in children between age 0 and 4 (inclusive). The average number of children per OA of these ages is 19.

4. The number of home visits that a child can expect to receive before age 5 is not known exactly. However, for this modelling we have based this on visits typically been required at:

    - age 10–15 days

    - age 6–8 weeks

    - age 7–9months

    - around age 2 years

    - a preschool visits at around age 4.

Number of visits

5. Driven by the first of these requirements, the modelling is based on a weekly visit to an Output Area if any of the children in the target groups have a birthday in a specific week. Since we don’t know the exact date of birth of any of the children, a probabilistic approach is used, where the probability that an OA will require a visit in a specific week is 1 minus the probability that none of the children have a birthday in a specific week.

6. To calculate this, for each category the probability is based on the binomial distribution with p = 1/52 and the number of trials equal to the number of children in the target range. So:

$$1 - \binom{n}{x} p^x (1-p)^{n-x}$$

$$= 1 - \binom{n}{0} (\frac{1}{52})^0 (1 - \frac{1}{52})^{n-0}$$

$$= 1 - (1 - \frac{1}{52})^n$$

7. So, if an OA had 4 children age zero, then the probability that one or more of these children would require a home visit in any one week is

$$1 - \left(1 - \frac{1}{52}\right)^4 = 0.075$$

8. This is repeated for each of the 5 visits, using the number of zero year olds for the first 3 visits, the average of the number of 1 and 2 year olds for the "around age 2 visit" and the average of the number of 3 and 4 year old for the "preschool" visit.

9. The overall probability that one of more visits to an OA will be required in any one week is therefore one minus the product of one minus these 5 probabilities. Or, we if had 4 children in each age band:

    1-(1-0.075)* (1-0.075)* (1-0.075)* (1-0.075)* (1-0.075) = 0.32

10. Based on this probability, we then draw one sample week for whether a visit is required or not for each OA in England. The average probability across OAs was 0.29 and the total visits required in the sample week of 50,119.

Number of routes

11. We have no specific information on the size of the population typically served by each Health Visitor, or their pattern of visiting in terms of home and clinic location. However, in 2011 there were 8000 full time equivalent Health Visitor in England so we therefore base each home visiting route as all the OAs from the sample above within each of 6791 MSOAs in England.

Routing methodology

12. To calculate the time to travel between each of the sampled OAs in each MSOA, we use Routefinder for Mapinfo software with Ordnance Surveys Mastermap ITN Network. We obtained data on road speeds for different specific roads (and sections of these roads) from the Highways Agency for trunk roads and data collected from LAs by the Department of Transport for local A roads.

13. The table below gives the median, 5th and 95th percentiles of speeds for urban and non-urban roads. There are over 4 million individual road segments in the network.

Road type		5th percentile	median	95th percentile
Motorway	Urban	32.5	60.0	70.0
A road	Urban	8.8	25.8	37.2
B road	Urban	11.5	23.1	27.4
Other roads	Urban	11.1	14.4	16.3
Motorway	non-urban	40.0	57.5	70.0
A road	non-urban	24.0	32.0	49.2
B road	non-urban	20.0	28.0	33.5
Other roads	non-urban	17.7	18.4	21.7

14. Additionally, travel not on roads is given a walking speed of 3mph.

15. To calculate the route, the software takes the population-weighted centroid of the MSOA as the starting point, and then calculates the total minimum time to drive around all the sampled OAs using an optimised travelling salesman algorithm.

Adjustments

16. Following the routing calculation, two adjustments are made to the travel time and visits.

17. Firstly, it is possible that more than one child shares a birthday in the same OA. This would reduce typically the average travel per visit. To take account of this, we use the formula in paragraph 5 to calculate the binomial probability if this for the OA that were already being visited and then aggregate this to MSOA level. Since it would be unreasonable to assume a zero travel time between two addresses in the same OA, we increase the total time by one half the average time between visits in different OAs.

18. Secondly, because the start point is based on the centroid of the MSOA, in some cases it is possible that this is located some distance from a road, which would have included a 3mph walking. To counter this we subtract the time taken to travel from the MSOA centroid to the nearest road node in the ITN dataset.

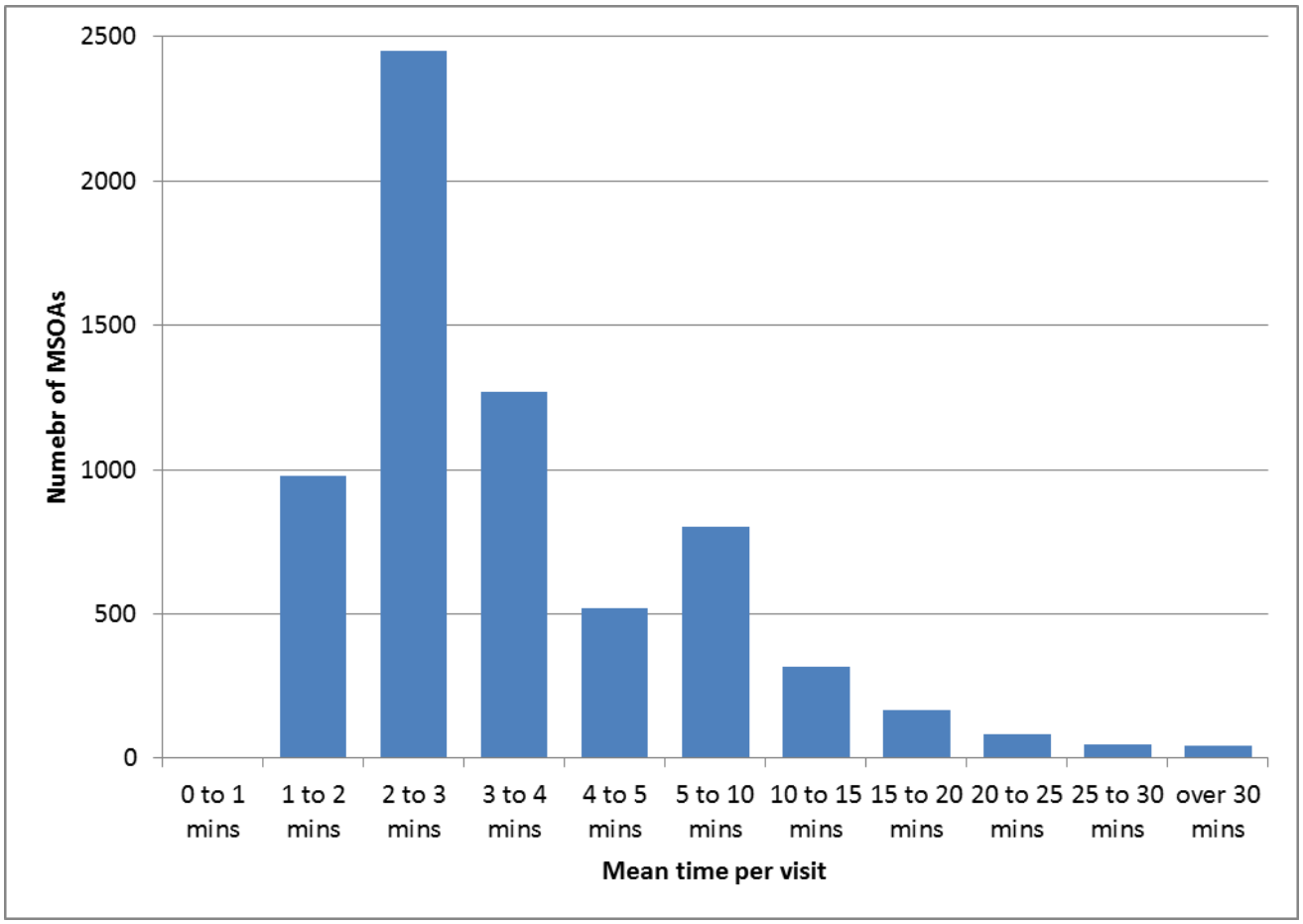
19. Thirdly, we adjust for estimated additional time taken to reach residences that are not located at ground level, for example in flats. To do this we linked OS data on residences with their data on building heights. By allowing a typical 3.1 metres per storey we were able to estimate the number residences by the floor on which they reside for every MSOA. We assume 30 seconds per floor above the first floor, which gives a range for LAs over all residences of between zero and 1¾ minutes (in City of London).per visit.

Results

20. Mapinfo completed the calculations in about 175 hours. It was able to successfully calculate route times for 6683 of the 6791 MSOAs. Those not calculated were the Isles of Scilly and 7 MSOAs that did not have any children to visit in the sampled week.

21. The mean total travel time, including the adjustments, in each MSOA was 29.7 minutes (median = 22.9) to make a mean 7.7 visits (median 7.2).

22. The mean travel time per visit was 4.7 minutes (median 3.0 minutes). The chart below shows the frequency distribution.



23. The highest average time was 79.9 minutes in MSOA E02004023 in south east Cumbria.

24. The table below shows the average impact of the actual travel times and adjustments by ONS Rural Urban Classification, and distribution through the MSOAs.

Rural Urban Classification of MSOA (2011) and percentiles. All figures are average time per visit in minutes	Travel time	Adjust-ment for same OA visits	Adjust-ment for MSOA centroid to road	Adjust-ment for building height	Overall ave time	Total impact of adjust-ments
Rural village and dispersed in a sparse setting	26.13	-0.19	-0.42	0.00	25.51	-0.61
Rural village and dispersed	16.47	-0.15	-0.31	0.00	16.01	-0.46
Rural town and fringe in a sparse setting	14.71	-0.08	-0.30	0.01	14.34	-0.37
Rural town and fringe	7.55	-0.08	-0.11	0.01	7.36	-0.18
Urban city and town in a sparse setting	5.27	-0.05	-0.05	0.01	5.18	-0.09
Urban city and town	3.60	-0.05	-0.05	0.03	3.53	-0.07
Urban minor conurbation	3.16	-0.04	-0.05	0.05	3.11	-0.05
Urban major conurbation	2.73	-0.05	-0.04	0.14	2.78	0.05
All	**4.81**	**-0.06**	**-0.08**	**0.07**	**4.74**	**-0.07**
Minimum MSOA	0.74	-0.70	-3.35	0.00	0.61	
5th Percentile MSOA	1.56	-0.16	-0.29	0.00	1.63	
Median MSOA	2.98	-0.05	-0.04	0.01	2.96	
95th Percentile MSOA	15.61	-0.01	-0.01	0.35	15.29	
Maximum MSOA	83.33	0.00	0.00	3.88	79.88	

25. The table below shows the overall time aggregated to upper tier LA (top and bottom 10).

LA code	LA name	Total visits	Mean time per visit (mins)
E09000031	Waltham Forest	306	1.8
E09000025	Newham	394	1.8
E09000012	Hackney	306	1.9
E09000014	Haringey	275	2.0
E09000002	Barking and Dagenham	285	2.0
E09000020	Kensington and Chelsea	170	2.0
E09000023	Lewisham	368	2.0
E09000026	Redbridge	293	2.0
E06000009	Blackpool	127	2.0
E06000032	Luton	247	2.1
E06000011	East Riding of Yorkshire	256	7.6
E10000008	Devon	596	7.9
E10000019	Lincolnshire	614	8.0
E10000006	Cumbria	411	8.1
E06000052	Cornwall	427	8.3
E06000057	Northumberland	266	8.5
E06000051	Shropshire	219	9.3
E06000019	Herefordshire, County of	157	9.6
E10000023	North Yorkshire	465	9.7
E06000017	Rutland	18	12.0

Implementation

26. These results suggest an ratio between the 10th highest and 10th lowest average LA travel time of 7.6:2.1 or 3.7:1. To turn this into an unavoidable cost index would require combine it with the average time for each home visit. This is not known but maybe obtainable from other sources. If it were 30 minutes then the ratio would be 1.17:1; if it were 45 minutes then 1.12:1.

27. Aside from this calculation, there is the question of whether the results from the travel time modelling are robust and stable, given that the OAs were selected as a probabilistic sample. One option would be to draw multiple samples and model each of these to check for consistency. However, as each run takes around 175 hours this is not very practical. A second option would be to try to use a regression model to predict the average times. This would also make the resulting index easier to update if it were not reliant on rerun the travelling salesman simulation each time.

Regression model

28. This is only an overview of the regression results without the detail of all the variables tested. The final variable specification was:

    - Dependant variable: ladjtimepervisit = ln (adjusted average time per visit)

- Independent variables:

  a) lchildrentoseeyrperhectare: ln (total expected visits per year per hectare) where expected visits is 3*0yrold+0.5*(1-4yrolds)

  b) lchildrentoseeyrperhectare2: the square of (a)

  c) lurban: Ln(the proportion of the area of the MSOA classed as urban settlement in OS Strategi. This is similar to the roads with 'urban' speed in the meridian 2 road network used)

  d) lurban2: the square of (c)

  e) lroadmpervisits: Ln(the total metres of road in the MSOA per visit)

  f) lroadmpervisits2: the square of (e)

  g) actualvsexpvisits: the ratio of the number of visits included in the modelling sample and the expected number based on the number of children in the MSOA

29. The model is constructed in natural logs given the non-linear relationship of the variables. The overall adjusted R^2 is 0.787. The outputs are in the table below.

ladjtimepervisit	Coef.	Std. Err.	t	P>t	Beta
lchildrentoseeyrperhectare	-0.074	0.016	-4.59	0.000	-0.193
lchildrentoseeyrperhectare2	-0.008	0.004	-2.32	0.021	-0.057
lpcurban	0.089	0.020	4.38	0.000	0.143
lpcurban2	-0.018	0.006	-3.07	0.002	-0.087
lroadmperchild	0.042	0.021	1.98	0.048	0.080
lroadmperchild2	0.042	0.003	14.57	0.000	0.595
actualvsexpvisits	-0.396	0.012	-33.95	0.000	-0.192

30. The coefficients are of the expected sign, so:

- Time per visit decreases as the number of children per hectare increases (all else equal). E.g. an increase from 0.05 to 2 children per hectare reduces travel time from 4.7 minutes to 3.3 minutes

- Time per visit increases if a greater proportion of the area is urban (all else equal). E.g. an increase in the % urban from 20% to 80% increases travel time from 3.4 to 3.7 minutes.

- Time per visit increases if there is more road in the area per child (all else equal). E.g. an increase in the road metres per child from 10 to 200 increase travel time from 2.5 to 7.2 minutes.

- If the modelling included more visits than we would have expected as the results of the random sampling then this reduced average travel time. This is treated as a supply variable and has a mean of 1 (zero after logging).

31. The model shows a good fit to the range of data. For example, taking the average of the 5% of MSOAs with the longest travel times gives a fitted of 15.2 compared to an actual of 20.7 and for the 5% shortest a fitted of 2.0 compared to an actual of 1.5

32. The table below shows the top and bottom 10 LAs by fitted travel time, showing the actual and difference from fitted. Rutland is a significant outlier, probably due to its size, with all other LA within ±1.6 minutes of the actual.

LA code	LA name	Total visits	Mean time per visit (mins) actual	Mean time per visit (mins) fitted	Difference (mins)
E09000012	Hackney	306	1.9	1.8	0.2
E09000030	Tower Hamlets	295	2.4	1.8	0.6
E09000013	Hammersmith and Fulham	202	2.4	1.8	0.6
E09000025	Newham	394	1.8	1.9	0.0
E09000028	Southwark	349	2.2	1.9	0.3
E09000019	Islington	207	2.7	1.9	0.8
E09000033	Westminster	215	2.2	1.9	0.3
E09000032	Wandsworth	380	2.1	1.9	0.2
E09000022	Lambeth	332	2.2	1.9	0.3
E09000020	Kensington and Chelsea	170	2.0	1.9	0.0
E06000011	East Riding of Yorkshire	256	7.6	7.2	0.4
E10000019	Lincolnshire	614	8.0	7.3	0.7
E06000052	Cornwall	427	8.3	8.1	0.2
E06000017	Rutland	18	12.0	8.9	3.0
E06000051	Shropshire	219	9.3	9.3	0.1
E10000006	Cumbria	411	8.1	9.3	-1.2
E10000008	Devon	596	7.9	9.4	-1.6
E06000057	Northumberland	266	8.5	9.5	-1.0
E10000023	North Yorkshire	465	9.7	9.9	-0.2
E06000019	Herefordshire, County of	157	9.6	10.2	-0.6

Annex C : Weighted population divided by unweighted population