# S2 Appendix for 'Hospital admissions for dementia in England: the effect of primary care quality'

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The material contained herein is supplementary to the article named in the title and submitted for consideration to PLOS ONE.

### Calculation of IRR for variables involving interaction terms

This note explains how the IRR for the Attendance Allowance (AA) and deprivation (IMD) variables reported in table 3 and 4 in the manuscript are calculated. $AA$ is a continuous variable measuring the percentage of AA claimants and $IMD_L$, $IMD_M$, $IMD_H$ are dummy variables indicating low, medium and high levels of deprivation:

$AA$: % of AA claimants
$IMD_L$ : % of people age 60 or older living in income deprivation is <20%
$IMD_M$ : % of people age 60 or older living in income deprivation is 20% - 35%
$IMD_H$ : %of people age 60 or older living in income deprivation is >35%

Using interaction terms we are able to calculate incident rate ratios for AA at different deprivation levels. We denote these IRRs as:

$IRR_{AA|IMD_L}$ : IRR for AA given that deprivation is low
$IRR_{AA|IMD_M}$ : IRR for AA given that deprivation is medium
$IRR_{AA|IMD_H}$ : IRR for AA given that deprivation is high
Similarly we denote the IRRs for medium and high deprivation as $IRR_{IMD_M}$ and $IRR_{IMD_H}$.

Suppressing practice and time subscripts, the conditional mean for the Poisson model with multiplicative gamma distributed random effects is:

$$E[y|Z,\theta] = \exp\left\{\alpha(AA) + \beta_1(IMD_M) + \beta_2(IMD_H) + \gamma_1(AA) * (IMD_M) + \gamma_2(AA) * (IMD_H) + X\delta\right\} \tag{1}$$

where $Z = (AA, IMD_M, IMD_H)$ is the vector of all explanatory variables and $\theta = (\alpha, \beta_1, \beta_2, \gamma_1, \gamma_2, \delta)$ is vector of parameters.

Then the IRRs are calculated as follows :

$$IRR_{AA|IMD_L} = \frac{\exp\{\alpha(AA+1) + X\delta\}}{\exp\{\alpha(AA) + X\delta\}} = \exp(\alpha) \tag{2}$$

$$IRR_{AA|IMD_M} = \frac{\exp\{\alpha(AA+1) + \beta_1 + \gamma_1(AA+1) + X\delta\}}{\exp\{\alpha(AA) + \beta_1 + \gamma_1(AA) + X\delta\}} = \exp(\alpha + \gamma_1) \tag{3}$$

$$IRR_{AA|IMD_H} = \frac{\exp\{\alpha(AA+1) + \beta_2 + \gamma_2(AA+1) + X\delta\}}{\exp\{\alpha(AA) + \beta_2 + \gamma_2(AA) + X\delta\}} = \exp(\alpha + \gamma_2) \tag{4}$$

$$IRR_{IMD_M} = \frac{\exp\{\alpha(AA) + \beta_1(IMD_M+1) + \gamma_1(AA)(IMD_M+1) + X\delta\}}{\exp\{\alpha(AA) + \beta_1(IMD_M) + \gamma_1(AA)(IMD_M) + X\delta\}} = \exp(\beta_1 + \gamma_1 AA) \tag{5}$$

$$IRR_{IMD_H} = \frac{\exp\{\alpha(AA) + \beta_2(IMD_H+1) + \gamma_2(AA)(IMD_H+1) + X\delta\}}{\exp\{\alpha(AA) + \beta_2(IMD_H) + \gamma_2(AA)(IMD_H) + X\delta\}} = \exp(\beta_2 + \gamma_2 AA) \tag{6}$$