**Supplementary material**

**Does pay-for-performance improve mental health related patient outcomes? The association between quality of primary care and suicide rates in England.**

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## Index of Multiple Deprivation

Area deprivation, as measured by the Index of Multiple Deprivation 2010 was available at the 2011 LSOA. The IMD measures relative levels of deprivation for all the 32,844 LSOAs in England on a continuous scale of deprivation where most of the indicators are based on 2008 and 2010 statistics [[1](#_ENREF_1)]. The IMD is calculated as weighted mean of 7 sub-domains, covering income, employment, health, education and skills, housing, crime, and environment.

## Index of Social Fragmentation

Congdon’s index [[2](#_ENREF_2)] is derived from census and migration data from the Nomis Official Labour Market Statistics website [[3](#_ENREF_3)] on: (1) One person households, %of all 2011 census households; (2) Married couple households, % all 2011 census households; (3) Population turnover (migrant inflow and outflow), % population (4) Households in private renting, %of all 2011 census. The social fragmentation index for each LSOA was calculated by adding the *z* scores (the number of standard deviations above or below the population mean when the underlying distribution is normal) for each of the four characteristics. The index represents neighborhood-level conditions which affect social resources such as social cohesion and social capital. The scores for the index of social fragmentation 2011 ranged from -4.6 to 13.69 across LSOAs and were only weakly correlated with the IMD scores (Pearson’s rho=0.09).

## Spatial Weighted analyses and attribution methodology

We used general practice level information from the HSCIC on several variables of interest to attribute it to our units of analyses, namely the LSOAs. We inputted the LSOA centroid coordinates (longitude and latitude) in R to create a 32,844x32,844 inverse distance matrix (in miles). This matrix features a detailed distance mapping of each LSOA with all other LSOAs and was used to quantify geographical proximity where nearby LSOAs have larger weights and also to generate prevalence and a measure for quality of care for all LSOAs from 2006-2007 to 2014-2015.

In 2014, the HSCIC published for the first time attribution datasets which linked general practice registers to LSOAs and vice versa [[4](#_ENREF_4)]. We used the relevant version of the attribution dataset (i.e. from 2015) as a blueprint to generate annual attribution datasets starting from 2014-15 and going back to 2006-07. Of the 8008 practices in our analyses, 7624 (95.2%) were identified in the attribution dataset, 296 practices (3.70%) had closed down or merged, while 88 new practices (1.1%) emerged. To calculate attribution rates for all years in order to subsequently quantify prevalence and quality of care we used regression modelling under various assumptions to obtain attribution estimates for previous years. For each LSOA, if two or more practices were linked to it, we fitted Poisson and negative binomial models with list size and distance to practice as predictors, and the model that was the best fit to the data was selected. If a practice was present both in the analyses and the attribution dataset, we adjusted the attributed population for practice’ list size in the respective year, thus assuming a constant attribution rate over time. If a practice was present in our analyses but not in the attribution dataset, we generated estimates using the models selected in step 1 across all years. If a LSOA was served entirely by a single practice, we assumed that this was the case in previous years. Those practices that emerged after our baseline year were used only to model the 2015 attribution in the area. Redistribution of patients to the other active practices within each year was achieved according to the selected regression model. In the same manner, for those practices that closed down or merged, their patients were re-distributed to the years in which they were active, according to their characteristics. Finally, the attribution counts estimated in the previous steps across practices and within each year were used to generate the weighted mean estimates for prevalence and quality of care. The algorithm is available from the corresponding author.

We assumed that the attribution rates remained constant over time, and we used this assumption to model the contribution of each practice; even the ones that had closed or merged by 2015. This method can possibly introduce uncertainty in the estimates which we could not include in the models because of methodological limitations. Even though the limitations and assumptions made for our approach could attenuate the relationship between quality of care and suicide, we would expect any strong relationship between our variables of interest to be detected as it was for example detected for prevalence of depression.

## Spatial Maps

Digital vector boundaries for the 2011 LSOAs, generalised to 20 metres and clipped to the coastline to reduce size and improve visualisation, were obtained from the ONS open geography portal [[5](#_ENREF_5)] . The vector boundaries were inputted in the Stata shp2dta command to calculate the centroid for each LSOA in the British National Grid format [[6](#_ENREF_6)]. These were then converted from British National Grid easting and northing to longitude and latitude in degrees [[7](#_ENREF_7)].

## Classification of deaths

Classification of deaths for the study used the International Classification of Diseases, 10th edition (ICD-10) and included all deaths with a final underlying cause recorded as intentional self-harm (X60-X84), injury/poisoning of undetermined intent (Y10-Y34, except Y33.9) and sequelae of intentional self-harm, or injury/poisoning of undetermined intent (Y87.0, Y87.2), which follows conventional practice for government suicide statistics in the UK.

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| **Table 1: ICD codes used to define suicide mortality (including open verdicts)** |
| X60 – X84 | Intentional self-harm |
| Y10 – Y34 | Events of undetermined intent |
| Y87.0 | Sequelae of intentional self-harm |
| Y87.2 | Sequelae of events of undetermined intent |

## Indicators included in the composite measure of quality of care

Several indicators were used over the study period (2006 - 2014) in the two mental health domains of interest (depression and SMI, including schizophrenia, bipolar disorder, or other psychosis) and were aggregated into a single score. Although these indicators have been revised or rephrased many times over the years, their underlying aim has consistently remained a) to identify patients with symptoms of depression and SMI b) to provide assessment and monitoring to those patients. Throughout the years of the scheme, some indicators were dropped while others were revised. When an indicator was dropped from the scheme, population achievement was calculated for each year from the remaining indicators. When an indicator was revised, the revision was concerned with the time span that measurement or treatment was taken or provided (e.g. for some indicators the time span was specified for 15 months but after the revision the time span was reduced to 12 months).

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| **Table 2: All QOF indicators included in the aggregate performance scores and their changes over time** |
| Indicator | Wording | Years active | Lt† | Ut† | P† |
| **DEP 1****(Recording/measurement)** | The percentage of patients on the diabetes register and /or the CHD register for whom case finding for depression has been undertaken on one occasion during the previous 15 months using two standard screening questions | 2006/2007 to 2010/2011 | 40 | 90 | 8 |
| **DEP 1****(Recording/measurement)** | The percentage of patients on the diabetes register and /or the CHD register for whom case finding for depression has been undertaken on one occasion during the previous 15 months using two standard screening questions | 2011/2012 to 2012/2013 | 40 | 90 | 6 |
| **DEP 001****(Recording/Measurement)** | The percentage of patients aged 18 or over with a new diagnosis of depression in the preceding 1 April to 31 March, who have had a bio-psychosocial assessment by the point of diagnosis. The completion of the assessment is to be recorded on the same day as the diagnosis is recorded. | 2013/2014  | 50 | 90 | 21 |
| **DEP 2****(Recording/measurement)** | In those patients with a new diagnosis of depression, recorded between the preceding 1 April to 31 March, the percentage of patients who have had an assessment of severity at the outset of treatment using an assessment tool validated for use in Primary Care | 2006/2007 to 2010/2011 | 40 | 90 | 25 |
| **DEP 4****(Recording/Measurement)** | In those patients with a new diagnosis of depression, recorded between the preceding 1 April to 31 March, the percentage of patients who have had an assessment of severity at the time of diagnosis using an assessment tool validated for use in Primary Care | 2011/2012 | 40 | 90 | 17 |
| **DEP 6****(Recording/Measurement)** | In those patients with a new diagnosis of depression, recorded between the preceding 1 April to 31 March, the percentage of patients who have had an assessment of severity at the time of diagnosis using an assessment tool validated for use in Primary Care | 2012/2013 | 50 | 90 | 17 |
| **DEP 002****(Recording/Measurement)** | The percentage of patients aged 18 or over with a new diagnosis of depression in the preceding 1 April to 31 March, who have been reviewed not earlier than 10 and not later than 35 days after the date of diagnosis | 2013/2014 | 45 | 80 | 10 |
| **DEP 003****(Recording/Measurement)** | The percentage of patients aged 18 or over with a new diagnosis of depression in the preceding 1 April to 31 March, who have been reviewed not earlier than 2 weeks after and not later than 8 weeks after the date of diagnosis | 2014/2015 | 45 | 80 | 10 |
| **DEP 3 (Recording/measurement)** | In those patients with a new diagnosis of depression and assessment of severity recorded between the preceding 1 April to 31 March, the percentage of patients who have had a further assessment of severity 5 – 12 weeks (inclusive) after the initial recording of the assessment of severity. Both assessments should be completed using an assessment tool validated for use in Primary Care.  | 2009/2010 to 2010/2011 | 40 | 90 | 20 |
| **DEP 5** **(Recording/Measurement)** | In those patients with a new diagnosis of depression and assessment of severity recorded between the preceding 1 April to 31 March, the percentage of patients who have had a further assessment of severity 4-12 weeks (inclusive) after the initial recording of the assessment of severity. Both assessments should be completed using an assessment tool validated for use in Primary Care | 2011/2012 | 40 | 80 | 8 |
| **DEP 7****(Recording/Measurement)** | In those patients with a new diagnosis of depression and assessment of severity recorded between the preceding 1 April to 31 March, the percentage of patients who have had a further assessment of severity 2 - 12 weeks (inclusive) after the initial recording of the assessment of severity. Both assessments should be completed using an assessment tool validated for use in Primary Care | 2012/2013 | 45 | 80 | 8 |
| **MH 4** **(Recording/measurement)** | The percentage of patients on lithium therapy with a record of serum creatinine and TSH in the preceding 15 months | 2006/2007 to 2010/2011 | 40 | 90 | 1 |
| **MH 17****(Recording/Measurement)** | The percentage of patients on lithium therapy with a record of serum creatinine and TSH in the preceding 9 months | 2011/2012  | 40 | 90 | 1 |
| **MH 17****(Recording/Measurement)** | The percentage of patients on lithium therapy with a record of serum creatinine and TSH in the preceding 9 months | 2012/2013 | 50 | 90 | 1 |
| **MH 9****(Recording/Measurement)** | The percentage of patients on lithium therapy with a record of serum creatinine and TSH in the preceding 9 months | 2013/2014 to 2014/2015 | 50 | 90 | 1 |
| **MH 5****(Treatment)** | The percentage of patients on lithium therapy with a record of lithium levels in the therapeutic range within the previous 6 months | 2006/2007 to 2010/2011 | 40 | 90 | 2 |
| **MH 18****(Treatment)** | The percentage of patients on lithium therapy with a record of lithium levels in the therapeutic range within the preceding 4 months | 2011/2012 to  | 40 | 90 | 2 |
| **MH 18****(Treatment)** | The percentage of patients on lithium therapy with a record of lithium levels in the therapeutic range within the preceding 4 months | 2012/2013 | 50 | 90 | 2 |
| **MH 10****(Treatment)** | The percentage of patients on lithium therapy with a record of lithium levels in the therapeutic range within the preceding 4 months | 2013/2014 to 2014/2015 | 50 | 90 | 2 |
| **MH 6** **(Treatment)** | The percentage of patients on the register who have a comprehensive care plan documented in the records agreed between individuals, their family and/or carers as appropriate | 2006/2007 to 2010/2011 | 25 | 50 | 6 |
| **MH 10****(Treatment)** | The percentage of patients on the register who have a comprehensive care plan documented in the records agreed between individuals, their family and/or careers as appropriate psychoses who have a record of blood pressure in the preceding 15 months | 2011/2012 | 25 | 50 | 6 |
| **MH 10****(Treatment)** | The percentage of patients on the register who have a comprehensive care plan documented in the records agreed between individuals, their family and/or careers as appropriate psychoses who have a record of blood pressure in the preceding 15 months | 2012/2013 | 30 | 55 | 6 |
| **MH 002****(Treatment)** | The percentage of patients on the register who have a comprehensive care plan documented in the records, in the previous 12 months agreed between individuals, their family and/or careers as appropriate | 2013/2014 to 2014/2015 | 40 | 90 | 6 |
| **MH 7****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who do not attend the practice for their annual review who are identified and followed up by the practice team within 14 days of nonattendance | 2006/2007 to 2010/2011 | 40 | 90 | 3 |
| **MH 9****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses with a review recorded in the preceding 15 months. In the review there should be evidence that the patient has been offered routine health promotion and prevention advice appropriate to their age, gender and health status | 2006/2007 to 2010/2011 | 40 | 90 | 23 |
| **MH 11****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of alcohol consumption in the preceding 15 months | 2011/2012  | 40 | 90 | 4 |
| **MH 11****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of alcohol consumption in the preceding 15 months |  2012/2013 | 50 | 90 | 4 |
| **MH 007****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of alcohol consumption in the preceding 12 months | 2013/2014 to 2014/2015 | 50 | 90 | 4 |
| **MH 12****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of BMI in the preceding 15 months | 2011/2012 | 40 | 90 | 4 |
| **MH 12****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of BMI in the preceding 15 months | 2012/2013 | 50 | 90 | 4 |
| **MH 006****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of BMI in the preceding 12 months | 2013/2014 | 50 | 90 | 4 |
| **MH 13****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of blood pressure in the preceding 15 months | 2011/2012 | 40 | 90 | 4 |
| **MH 13****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of blood pressure in the preceding 15 months | 2012/2013 | 50 | 90 | 4 |
| **MH 003****(Recording/Measurement)** | The percentage of patients with schizophrenia, bipolar affective disorder and other psychoses who have a record of blood pressure in the preceding 12 months | 2013/2014 to 2014/2015 | 50 | 90 | 4 |
| **MH 14****(Recording/Measurement)** | The percentage of patients aged 40 years and over with schizophrenia, bipolar affective disorder and other psychoses who have a record of total cholesterol:hdl ratio in the preceding 15 months | 2011/2012 | 40 | 80 | 5 |
| **MH 19****(Recording/Measurement)** | The percentage of patients aged 40 years and over with schizophrenia, bipolar affective disorder and other psychoses who have a record of total cholesterol:hdl ratio in the preceding 15 months | 2012/2013 | 45 | 80 | 5 |
| **MH 004****(Recording/Measurement)** | The percentage of patients aged 40 years and over with schizophrenia, bipolar affective disorder and other psychoses who have a record of total cholesterol:hdl ratio in the preceding 12 months | 2013/2014 | 45 | 80 | 5 |
| **MH 15****(Recording/Measurement)** | The percentage of patients aged 40 years and over with schizophrenia, bipolar affective disorder and other psychoses who have a record of blood glucose level in the preceding 15 months | 2011/2012 | 40 | 80 | 5 |
| **MH 20****(Recording/Measurement)** | The percentage of patients aged 40 years and over with schizophrenia, bipolar affective disorder and other psychoses who have a record of blood glucose or HbA1c in the preceding15 months | 2012/2013 | 45 | 80 | 5 |
| **MH 005****(Recording/Measurement)** | The percentage of patients aged 40 years and over with schizophrenia, bipolar affective disorder and other psychoses who have a record of blood glucose level in the preceding 12 months | 2013/2014 | 45 | 80 | 5 |
| **MH 16****(Recording/Measurement)** | The percentage of patients (aged from 25 to 64 in England and Northern Ireland, from 20 to 60 in Scotland and from 20 to 64 in Wales) with schizophrenia, bipolar affective disorder and other psychoses whose notes record that a cervical screening test has been performed in the preceding 5 years | 2011/2012 | 40 | 80 | 6 |
| **MH 16****(Recording/Measurement)** | The percentage of patients (aged from 25 to 64 in England and Northern Ireland, from 20 to 60 in Scotland and from 20 to 64 in Wales) with schizophrenia, bipolar affective disorder and other psychoses whose notes record that a cervical screening test has been performed in the preceding 5 years | 2012/2013 | 45 | 80 | 5 |
| **MH 008****(Recording/Measurement)** | The percentage of patients (aged from 25 to 64 in England and Northern Ireland, from 20 to 60 in Scotland and from 20 to 64 in Wales) with schizophrenia, bipolar affective disorder and other psychoses whose notes record that a cervical screening test has been performed in the preceding 5 years | 2013/2014 to 2014/2015 | 45 | 80 | 5 |

**† Lt**: Lower threshold; **Ut**: Upper threshold; **P**: points indicator is worth (1 point≈£126). Also, **P= min{( Ut – Lt), (RA – Lt)/( Ut – Lt))** where **RA** is the practice reported achievement (excluding exception reported patients) under the Quality and Outcomes Framework.

## Sensitivity analyses results

We were also concerned with any potential confounding that may have been introduced in our analysis due to collinearity between the 18 age groups. In order to address this we ran a sensitivity analysis with 4 age groups and exactly the same covariates across all models. The results from our sensitivity analyses were very similar to the results from the principal analysis and the coefficients had the same direction.). For the 4 age-band models the results when compared to the 18 age-band model were identical (1.05 95% CI [1.04 to 1.05]) while on the other hand the zero inflated negative binomial models exhibited larger effects (1.06 95% CI [1.05 to 1.07]) of social fragmentation on suicide when compared to the negative binomial 4-age band model. A percentage point increase in population social fragmentation was associated with an increase of 7.7% in suicide (312 deaths by suicide) nationally.

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| **Table 3 - Regression Analysis set 1: Effect of Mental Health QOF Population Achievement on suicide over time (Zero Inflated Negative Binomial Model).**95% Confidence Intervals are in brackets, Results are reported as incidence rate ratios (IRR) followed by P-values and Standard Errors in parentheses. |
| **Year:** | Lag=0\* | Lag=1\* | Lag=2\* | Lag=3\* |
| **% Population achievement**  | 1.00 (0.99 to 1.002 ), <0.844 (0.009) | 1.00 (0.99 to 1.00), <0.698 (0.001) | **No Convergence** | **No Convergence** |
|  **Female** | 0.29 (0.28 to 0.30),<0.001 (0.003) | 0.29 (0.28 to 0.30)<0.001 (0.003) | ~~-~~ | ~~-~~ |
| **Index of Multiple Deprivation 2010** | 1.01 (1.01 to 1.01), <0.001 (0.0003) | 1.01 (1.01 to 1.01), <0.001 (0.0004) | ~~-~~ | ~~-~~ |
| **Rural (v urban)** | 1.06 (1.03 to 1.09), <0.001 (0.016) | 1.07 (1.03 to 1.10), <0.001 (0.017) | ~~-~~ | ~~-~~ |
| **Prevalence of Depression** | 1.01 (1.00 to 1.02), <0.007 (0.004) | 1.01 (1.00 to 1.02), <0.007 (0.045) | ~~-~~ | ~~-~~ |
| **Prevalence of Severe Mental Illness** | 1.05 (0.96 to 1.06),<0.486 (0.025) | 1.00 (0.95 to 1.06),<0.772 (0.026) | ~~-~~ | ~~-~~ |
| **Index of Social Frag.** | 1.07 (1.07 to 1.08),<0.001 (0.003) | 1.07 (1.07 to 1.08),<0.001 (0.003) | ~~-~~ | ~~-~~ |
| **Ethnicity (%White)** | 1.00 (1.00 to 1.00),<0.001 (0.0003) | 1.00 (1.00 to 1.00),<0.001 (0.003) | ~~-~~ | ~~-~~ |
| **Age (20-24)** | *Reference age group* | *Reference age group* | ~~-~~ | ~~-~~ |
| **Age (25-29)** | 1.08 (1.03 to 1.14),<0.002 (0.029) | 1.07 (1.01 to 1.13)<0.013 (0.030) | ~~-~~ | ~~-~~ |
| **Age (30-34)** | 1.23 (1.17 to 1.30)<0.001 (0.032) | 1.22 (1.15 to 1.28)<0.001 (0.034) | ~~-~~ | ~~-~~ |
| **Age (35-39)** | 1.51 (1.44 to 1.59)<0.001 (0.038) | 1.49 (1.41 to 1.57)<0.001 (0.040) | ~~-~~ | ~~-~~ |
| **Age (40-44)** | 1.67 (1.59 to 1.75),<0.001 (0.041) | 1.67 (1.59 to 1.76)<0.001 (0.042) | ~~-~~ | ~~-~~ |
| **Age (45-49)** | 1.63 (1.55 to 1.71),<0.001 (0.040) | 1.63 (1.55 to 1.72)<0.001 (0.042) | ~~-~~ | ~~-~~ |
| **Age (50-54)** | 1.60 (1.52 to 1.68),<0.001 (0.041) | 1.60 (1.51 to 1.69)<0.001 (0.043) | ~~-~~ | ~~-~~ |
| **Age (55-59)** | 1.39 (1.32 to 1.47),<0.001 (0.037) | 1.38 (1.30 to 1.46)<0.001 (0.039) | ~~-~~ | ~~-~~ |
| **Age (60-64)** | 1.09 (1.03 to 1.16),<0.001 (0.031) | 1.08 (1.02 to 1.15)<0.006 (0.032) | ~~-~~ | ~~-~~ |
| **Age (65-69)** | 0.87 (0.81 to 0.92),<0.599 (0.028) | 0.86 (0.80 to 0.91)<0.001 (0.029) | ~~-~~ | ~~-~~ |
| **Age (70-74)** | 0.82 (0.77 to 0.88),<0.792 (0.029) | 0.82 (0.76 to 0.88)<0.001 (0.030) | ~~-~~ | ~~-~~ |
| **Age (75-79)** | 0.87 (0.81 to 0.93),<0.103 (0.032) | 0.86 (0.79 to 0.93)<0.001 (0.033) | ~~-~~ | ~~-~~ |
| **Age (80-84)** | 1.07 (0.99 to 1.16),<0.054 (0.042) | 1.06 (0.98 to 1.15)<0.119 (0.044) | ~~-~~ | ~~-~~ |
| **Age (85plus)** | 1.23 (1.14 to 1.33) <0.001 (0.049) | 1.22 (1.12 to 1.32) <0.001 (0.051) | ~~-~~ | ~~-~~ |
|  **2006** | *Reference Year* | *Reference Year* | ~~-~~ | ~~-~~ |
|  **2007** |  0.94 (0.90 to 0.98),<0.014 (0.021) | - | ~~-~~ | ~~-~~ |
| **2008** | 1.00 (0.96 to 1.05), <0.796 (0.022) | 1.06 (1.01 to 1.10),<0.008 (0.024) | ~~-~~ | ~~-~~ |
| **2009** | 1.02 (0.97 to 1.06), <0.345 (0.022) | 1.07 (1.03 to 1.12), <0.001 (0.024) | ~~-~~ | ~~-~~ |
| **2010** | 0.97 (0.93 to 1.01), <0.229 (0.021) | 1.02 (0.98 to 1.07), <0.197 (0.023) | ~~-~~ | ~~-~~ |
| **2011** | 1.03 (0.99 to 1.08), <0.123 (0.022) | 1.09 (1.04 to 1.14), <0.001 (0.024) | ~~-~~ | ~~-~~ |
| **2012** | 0.96 (0.89 to 1.02), <0.247 (0.033) | 1.01 (0.95 to 1.09), <0.601 (0.035) | ~~-~~ | ~~-~~ |
| **2013** | 0.99 (0.92 to 1.06),<0.835 (0.036) | 1.05 (0.97 to 1.13)<0.161 (0.040) | ~~-~~ | ~~-~~ |
|  **2014** | 1.00 (0.92 to 1.08),<0.892 (0.040) | 1.07 (0.99 to 1.16)<0.078 (0.043) | ~~-~~ | ~~-~~ |
| **Model intercept** | 0.0009 (0.00007 to 0.00011), <0.001 (0.0000) | 0.0007 (0.0006 to 0.0008), <0.001 (0.0001) | ~~-~~ | ~~-~~ |
| **Inflation (Population)** | -1.51 (-2.45 to -0.57),(0.47) | 0.006 (0.005 to 0.007),<0.001 (0.0005) | ~~-~~ | ~~-~~ |
| **Logit Model Constant** | 0.22 (-0.70 to -0.39),<0.001 (0.077) | -0.58 (-0.74 to -0.41),<0.001 (0.082) | ~~-~~ | ~~-~~ |

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| **Table 4 - Regression Analysis set 2: Effect of Mental Health QOF Population Achievement on suicide over time (4 Age bands Negative Binomial Model)**95% Confidence Intervals are in brackets, Results are reported as incidence rate ratios (IRR) followed by P-values and Standard Errors in parentheses. |
| **Year:** | Lag=0\* | Lag=1\* | Lag=2\* | Lag=3\* |
| **% Population achievement**  | 1.00 (0.99 to 1.00 ), <0.457 (0.004) | 1.00 (0.99 to 1.00), <0.462 (0.001) | 1.00 (0.99 to 1.00), <0.854 (0.001) | 1.00 (0.99 to 1.00), <0.564 (0.001) |
|  **Female** | 0.29 (0.29 to 0.30),<0.001 (0.003) | 0.29 (0.28 to 0.30),<0.001 (0.003) | 0.29 (0.28 to 0.30),<0.001 (0.003) | 0.29 (0.28 to 0.30),<0.001 (0.003) |
| **Index of Multiple Deprivation 2010** | 1.01 (1.01 to 1.01), <0.001 (0.0003) | 1.01 (1.01 to 1.01), <0.001 (0.0003) | 1.01 (1.01 to 1.01), <0.001 (0.0004) | 1.01 (1.01 to 1.01), <0.001 (0.0004) |
| **Rural (v urban)** | 1.04 (1.01 to 1.08), <0.001 (0.016) | 1.05 (1.02 to 1.08), <0.001 (0.017) | 1.05 (1.01 to 1.09), <0.001 (0.018) | 1.04 (1.00 to 1.08), <0.023 (0.019) |
| **Prevalence of Depression** | 1.01 (1.00 to 1.02), <0.005 (0.004) | 1.01 (1.00 to 1.02), <0.006 (0.004) | 1.01 (1.00 to 1.02), <0.008 (0.004) | 1.01 (1.00 to 1.01), <0.019 (0.004) |
| **Prevalence of Severe Mental Illness** | 1.05 (1.00 to 1.10),<0.040 (0.026) | 1.04 (0.99 to 1.09),<0.102 (0.027) | 1.03 (0.97 to 1.00),<0.249 (0.028) | 1.03 (0.98 to 1.10),<0.180 (0.030) |
| **Index of Social Frag.** | 1.05 (1.04 to 1.05),<0.001 (0.003) | 1.05 (1.04 to 1.05),<0.001 (0.003) | 1.05 (1.04 to 1.06),<0.001 (0.003) | 1.05 (1.04 to 1.06),<0.001 (0.003) |
| **Age (20-24)** | *Reference age group* | *Reference age group* | *Reference age group* | *Reference age group* |
| **Age (25-29)** | 1.16 (1.10 to 1.22),<0.001 (0.31) | 1.14 (1.08 to 1.21),<0.001 (0.32) | 1.14 (1.07 to 1.21),<0.001 (0.34) | 1.14 (1.07 to 1.22),<0.001 (0.37) |
| **Age (30-49)** | 1.68 (1.61 to 1.76),<0.001 (0.037) | 1.67 (1.60 to 1.75),<0.001 (0.038) | 1.66 (1.58 to 1.74),<0.001 (0.040) | 1.67 (1.58 to 1.76),<0.001 (0.044) |
| **Age (50-64)** | 1.57 (1.50 to 1.64),<0.399 (0.036) | 1.55 (1.48 to 1.63),<0.001 (0.038) | 1.55 (1.47 to 1.63),<0.001 (0.040) | 1.58 (1.49 to 1.67),<0.001 (0.044) |
| **Age (65+)** | 1.12 (1.06 to 1.17) <0.001 (0.027) | 1.10 (1.04 to 1.15) <0.001 (0.028) | 1.08 (1.03 to 1.14) <0.002 (0.029) | 1.09 (1.02 to 1.15) <0.003 (0.032) |
|  **2006** | *Reference Year* | *Reference Year* | *Reference Year* | *Reference Year* |
|  **2007** | 0.94 (0.90 to 0.98),<0.012 (0.021) | ~~-~~ | ~~-~~ | ~~-~~ |
| **2008** | 1.00 (0.95 to 1.04), <0.908 (0.022) | 1.05 (1.01 to 1.10), <0.010 (0.023) | ~~-~~ | ~~-~~ |
| **2009** | 1.01 (0.97 to 1.06), <0.441 (0.022) | 1.07 (1.02 to 1.12), <0.002 (0.024) | 1.01 (0.96 to 1.05), <0.643 (0.022) | ~~-~~ |
| **2010** | 0.96 (0.92 to 1.00), <0.120 (0.021) | 1.02 (0.97 to 1.06), <0.309 (0.023) | 0.96 (0.91 to 1.00), <0.080 (0.021) | 0.94 (0.90 to 0.99), <0.020 (0.021) |
| **2011** | 1.02 (0.97 to 1.06), <0.299 (0.022) | 1.08 (1.03 to 1.13), <0.001 (0.024) | 1.02 (0.97 to 1.06), <0.329 (0.022) | 1.00 (0.96 to 1.05), <0.714 (0.022) |
| **2012** | 0.94 (0.88 to 1.01), <0.108 (0.032) | 1.00 (0.93 to 1.07), <0.875 (0.035) | 0.94 (0.88 to 1.01), <0.129 (0.033) | 0.94 (0.88 to 1.01), <0.097 (0.032) |
| **2013** | 0.97 (0.90 to 1.05),<0.528 (0.036) | 1.04 (0.96 to 1.12),<0.288 (0.039) | 0.98 (0.91 to 1.05),<0.659 (0.037) | 0.98 (0.91 to 1.05),<0.592 (0.036) |
|  **2014** | 0.98 (0.91 to 1.06),<0.722 (0.039) | 1.05 (0.97 to 1.14),<0.165 (0.043) | 1.00 (0.92 to 1.08),<0.944 (0.041) | 0.99 (0.91 to 1.08),<0.942 (0.041) |
| **Model intercept** | 0.00003 (0.00003 to 0.00004), <0.001 (0.00001) | 0.00003 (0.00002 to 0.00004), <0.001 (0.00001) | 0.00003 (0.00002 to 0.00004), <0.001 (0.00001) | 0.00003 (0.00002 to 0.00003), <0.001 (0.00001) |

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| **Table 5 - Regression Analysis set 3: Effect of Mental Health QOF Population Achievement on suicide post the 2008 economic recession**95% Confidence Intervals are in brackets, Results are reported as incidence rate ratios (IRR) followed by P-values and Standard Errors in parentheses. |
| **Year:** | Lag=0\* | Lag=1\* | Lag=2\* | Lag=3\* |
| **% Population achievement**  | 1.00 (0.99 to 1.00 ), <0.083 (0.001) | 1.00 (0.99 to 1.00 ), <0.437 (0.001) | 1.00 (0.99 to 1.00 ), <0.553 (0.001) | 1.00 (0.99 to 1.00 ), <0.575 (0.001) |
|  **Female** | 0.29 (0.28 to 0.30),<0.001 (0.004) | 0.29 (0.28 to 0.30),<0.001 (0.004) | 0.29 (0.28 to 0.30),<0.001 (0.004) | 0.29 (0.28 to 0.30),<0.001 (0.004) |
| **Index of Multiple Deprivation 2010** | 1.01 (1.01 to 1.01), <0.001 (0.004) | 1.01 (1.01 to 1.01), <0.001 (0.004) | 1.01 (1.01 to 1.01), <0.001 (0.004) | 1.01 (1.01 to 1.01), <0.001 (0.004) |
| **Rural (v urban)** | 1.04 (1.00 to 1.07), <0.031 (0.018) | 1.04 (1.00 to 1.07), <0.029 (0.018) | 1.04 (1.00 to 1.07), <0.027 (0.018) | 1.04 (1.00 to 1.07), <0.026 (0.019) |
| **Prevalence of Depression** | 1.01 (1.00 to 1.02), <0.017 (0.004) | 1.01 (1.00 to 1.02), <0.017 (0.004) | 1.01 (1.00 to 1.02), <0.018 (0.004) | 1.01 (1.00 to 1.02), <0.018 (0.004) |
| **Prevalence of Severe Mental Illness** | 1.03 (0.98 to 1.10),<0.181 (0.030) | 1.03 (0.98 to 1.10),<0.173 (0.030) | 1.04 (0.98 to 1.10),<0.165 (0.030) | 1.04 (0.98 to 1.10),<0.167 (0.030) |
| **Index of Social Frag.** | 1.05 (1.04 to 1.06),<0.001 (0.003) | 1.05 (1.04 to 1.06),<0.001 (0.003) | 1.05 (1.04 to 1.06),<0.001 (0.003) | 1.05 (1.04 to 1.06),<0.001 (0.003) |
| **Ethnicity (%White)** | 1.00 (1.00 to 1.00),<0.001 (0.000) | 1.00 (1.00 to 1.00),<0.001 (0.000) | 1.00 (1.00 to 1.00),<0.001 (0.000) | 1.00 (1.00 to 1.00),<0.001 (0.000) |
| **Age (20-24)** | *Reference age group* | *Reference age group* | *Reference age group* | *Reference age group* |
| **Age (25-29)** | 1.14 (1.07 to 1.22),<0.001 (0.027) | 1.14 (1.07 to 1.22),<0.001 (0.037) | 1.14 (1.07 to 1.22),<0.001 (0.037) | 1.14 (1.07 to 1.22),<0.001 (0.037) |
| **Age (30-34)** | 1.27 (1.19 to 1.36)<0.001 (0.041) | 1.27 (1.19 to 1.36)<0.001 (0.041) | 1.27 (1.19 to 1.36)<0.001 (0.041) | 1.27 (1.19 to 1.36)<0.001 (0.041) |
| **Age (35-39)** | 1.65 (1.55 to 1.75)<0.001 (0.052) | 1.65 (1.55 to 1.75)<0.001 (0.052) | 1.65 (1.55 to 1.75)<0.001 (0.052) | 1.65 (1.55 to 1.75)<0.001 (0.052) |
| **Age (40-44)** | 1.88 (1.77 to 2.00),<0.001 (0.057) | 1.88 (1.77 to 2.00),<0.001 (0.057) | 1.88 (1.77 to 2.00),<0.001 (0.057) | 1.88 (1.77 to 2.00),<0.001 (0.057) |
| **Age (45-49)** | 1.87 (1.76 to 1.99),<0.001 (0.057) | 1.87 (1.76 to 1.99),<0.001 (0.057) | 1.87 (1.76 to 1.99),<0.001 (0.057) | 1.87 (1.76 to 1.99),<0.001 (0.057) |
| **Age (50-54)** | 1.86 (1.75 to 1.98),<0.001 (0.058) | 1.86 (1.75 to 1.98),<0.001 (0.058) | 1.86 (1.75 to 1.98),<0.001 (0.058) | 1.86 (1.75 to 1.98),<0.001 (0.058) |
| **Age (55-59)** | 1.61 (1.51 to 1.72),<0.001 (0.053) | 1.61 (1.51 to 1.72),<0.001 (0.053) | 1.61 (1.51 to 1.72),<0.001 (0.053) | 1.61 (1.51 to 1.72),<0.001 (0.053) |
| **Age (60-64)** | 1.24 (1.16 to 1.33),<0.001 (0.043) | 1.24 (1.16 to 1.33),<0.001 (0.043) | 1.24 (1.16 to 1.33),<0.001 (0.043) | 1.24 (1.16 to 1.33),<0.001 (0.043) |
| **Age (65-69)** | 0.98 (0.91 to 1.06),<0.699 (0.038) | 0.98 (0.91 to 1.06),<0.696 (0.038) | 0.98 (0.91 to 1.06),<0.692 (0.038) | 0.98 (0.91 to 1.06),<0.692 (0.038) |
| **Age (70-74)** | 0.98 (0.90 to 1.07),<0.757 (0.041) | 0.98 (0.90 to 1.07),<0.753 (0.041) | 0.98 (0.90 to 1.07),<0.749 (0.041) | 0.98 (0.90 to 1.07),<0.749 (0.041) |
| **Age (75-79)** | 1.04 (0.95 to 1.13),<0.326 (0.045) | 1.04 (0.95 to 1.13),<0.329 (0.045) | 1.04 (0.95 to 1.13),<0.331 (0.045) | 1.04 (0.95 to 1.13),<0.331 (0.045) |
| **Age (80-84)** | 1.26 (1.15 to 1.38),<0.001 (0.058) | 1.26 (1.14 to 1.38),<0.001 (0.058) | 1.26 (1.14 to 1.38),<0.001 (0.058) | 1.26 (1.14 to 1.38),<0.001 (0.058) |
| **Age (85plus)** | 1.51 (1.38 to 1.65) <0.001 (0.069) | 1.51 (1.38 to 1.65) <0.001 (0.069) | 1.51 (1.38 to 1.65) <0.001 (0.069) | 1.51 (1.38 to 1.65) <0.001 (0.069) |
|  **2009** | *Reference Year* | *Reference Year* | *Reference Year* | *Reference Year* |
|  **2010** | 0.94 (0.90 to 0.99), <0.019 (0.020) | 0.95 (0.91 to 0.99), <0.032 (0.021) | 0.95 (0.90 to 0.99), <0.024 (0.021) | 0.95 (0.90 to 0.99), <0.022 (0.021) |
| **2011** | 1.00 (0.96 to 1.05), <0.663 (0.021) | 1.00 (0.96 to 1.05), <0.636 (0.021) | 1.01 (0.96 to 1.05), <0.606 (0.022) | 1.00 (0.96 to 1.05), <0.695 (0.022) |
| **2012** | 0.94 (0.88 to 1.00), <0.086 (0.032) | 0.94 (0.88 to 1.01), <0.108 (0.032) | 0.94 (0.88 to 1.01), <0.095 (0.032) | 0.94 (0.88 to 1.01), <0.091 (0.032) |
| **2013** | 0.98 (0.91 to 1.05),<0.637 (0.036) | 0.98 (0.91 to 1.05),<0.621 (0.036) | 0.98 (0.91 to 1.05),<0.612 (0.036) | 0.98 (0.91 to 1.05),<0.566 (0.036) |
|  **2014** | 0.99 (0.91 to 1.07),<0.847 (0.039) | 1.00 (0.92 to 1.08),<0.973 (0.041) | 0.99 (0.91 to 1.08),<0.947 (0.041) | 1.00 (0.91 to 1.08),<0.913 (0.041) |
| **Model intercept** | 0.0003 (0.00002 to 0.00004), <0.001 (0.0000) | 0.0003 (0.00002 to 0.00004), <0.001 (0.0000) | 0.0003 (0.00002 to 0.00004), <0.001 (0.0000) | 0.0003 (0.00002 to 0.00004), <0.001 (0.0000) |
| **Inflation (Population)** | -1.51 (-2.45 to -0.57), (0.479) | -1.51 (-2.45 to -0.57), (0.480) | -1.51 (-2.45 to -0.57), (0.480) | -1.51 (-2.45 to -0.57), (0.480) |
| **Logit Model Constant** | 0.22 (0.086 to 0.56), (0.105) | 0.22 (0.086 to 0.56), (0.105) | 0.22 (0.086 to 0.56), (0.105) | 0.22 (0.086 to 0.56), (0.105) |

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| **Table 6 - Regression Analysis set 4: Effect of Mental Health QOF Population Achievement on Suicide vs Open Verdicts over time.**95% Confidence Intervals are in brackets, Results are reported as incidence rate ratios (IRR) followed by P-values and Standard Errors in parentheses. |
|  |  |
|  | Definite Suicides | Open Verdicts |
| **% Population achievement**  |  0.99 (0.99 to 1.00 ),<0.766 (0.001) | 1.00 (1.00 to 1.00), <0.039 (0.001) |
|  **Female** | 0.26 (0.25 to 0.27),<0.001 (0.003) | 0.39 (0.38 to 0.41)<0.001 (0.009) |
| **Index of Multiple Deprivation 2010** | 1.01 (1.01 to 1.01), <0.001 (0.000) | 1.02 (1.02 to 1.02), <0.001 (0.000) |
| **Rural (v urban)** | 1.06 (1.03 to 1.10), <0.001 (0.018) | 0.95 (0.89 to 1.02), <0.215 (0.032) |
| **Prevalence of Depression** | 1.02 (1.01 to 1.03), <0.001 (0.005) | 0.97 (0.96 to 0.99), <0.025 (0.009) |
| **Prevalence of Severe Mental Illness** | 1.02 (0.96 to 1.08),<0.393 (0.029) | 1.14 (1.04 to 1.25),<0.003 (0.053) |
| **Index of Social Frag.** | 1.05 (1.04 to 1.06),<0.001 (0.003) | 1.05 (1.04 to 1.06),<0.001 (0.005) |
| **Ethnicity (%White)** | 1.00 (1.00 to 1.01),<0.001 (0.000) | 1.00 (1.00 to 1.00),<0.001 (0.000) |
| **Age (20-24)** | *Reference age group* | *Reference age group* |
| **Age (25-29)** | 1.18 (1.11 to 1.26),<0.001 (0.037) | 1.09 (0.98 to 1.20)<0.084 (0.056) |
| **Age (30-34)** | 1.37 (1.29 to 1.46)<0.001 (0.043) | 1.32 (1.19 to 1.45)<0.001 (0.066) |
| **Age (35-39)** | 1.72 (1.62 to 1.83)<0.001 (0.052) | 1.62 (1.47 to 1.78)<0.001 (0.079) |
| **Age (40-44)** | 1.88 (1.78 to 2.00),<0.001 (0.055) | 1.82 (1.65 to 2.00)<0.001 (0.087) |
| **Age (45-49)** | 1.91 (1.80 to 2.02),<0.001 (0.057) | 1.63 (1.48 to 1.80)<0.001 (0.080) |
| **Age (50-54)** | 1.93 (1.82 to 2.05),<0.001 (0.058) | 1.54 (1.40 to 1.71)<0.001 (0.078) |
| **Age (55-59)** | 1.69 (1.59 to 1.80),<0.001 (0.053) | 1.38 (1.24 to 1.54)<0.001 (0.074) |
| **Age (60-64)** | 1.33 (1.24 to 1.42),<0.001 (0.044) | 1.07 (0.95 to 1.20)<0.215 (0.062) |
| **Age (65-69)** | 1.06 (0.99 to 1.14),<0.077 (0.039) | 0.88 (0.77 to 1.00)<0.058 (0.057) |
| **Age (70-74)** | 1.03 (0.95 to 1.12),<0.355 (0.041) | 0.86 (0.75 to 0.99)<0.045 (0.060) |
| **Age (75-79)** | 1.14 (1.05 to 1.24),<0.001 (0.047) | 0.83 (0.72 to 0.97)<0.020 (0.064) |
| **Age (80-84)** | 1.36 (1.24 to 1.48),<0.001 (0.060) | 1.28 (1.11 to 1.48)<0.001 (0.095) |
| **Age (85plus)** | 1.54 (1.41 to 1.68) <0.001 (0.069) | 1.52 (1.32 to 1.75) <0.001 (0.110) |
| **2006** | *Reference Year* | *Reference Year* |
| **2007** | 0.94 (0.89 to 0.99), <0.036 (0.024) | 0.93 (0.86 to 1.02), <0.154 (0.041) |
|  **2008** | 1.02 (0.97 to 1.08), <0.269 (0.026) | 0.92 (0.85 to 1.01), <0.086 (0.040) |
| **2009** | 1.03 (0.97 to 1.08), <0.251 (0.026) | 0.98 (0.90 to 1.06), <0.662 (0.042) |
| **2010** | 0.98 (0.94 to 1.04), <0.685 (0.025) | 0.90 (0.82 to 0.98), <0.018 (0.039) |
| **2011** | 1.04 (0.99 to 1.10), <0.080 (0.026) | 0.96 (0.88 to 1.04), <0.374 (0.041) |
| **2012** | 0.91 (0.84 to 0.98), <0.025 (0.035) | 1.06 (0.92 to 1.22),<0.361 (0.076) |
| **2013** | 0.95 (0.88 to 1.03),<0.287 (0.040) | 1.06 (0.91 to 1.23)<0.419 (0.081) |
|  **2014** | 0.97 (0.89 to 1.07),<0.651 (0.044) | 1.01 (0.86 to 1.19)<0.854 (0.085) |
| **Model intercept** | 0.0002 (0.00002 to 0.00003), <0.001 (0.0000) | 0.0002 (0.00002 to 0.00003), <0.001 (0.0000) |

## Figures



**Fig 1A:** Suicide Incidence Rates in England, by English Regions in 2006.



**Fig 1B:** Suicide Incidence Rates in England, by English Regions in 2014.

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