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## Rates of turnover among general practitioners in England between 2007-2019: a retrospective study

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# Rates of turnover among general practitioners in England between 2007-2019: a retrospective study

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## Abstract

### Objective

To quantify general practitioners' (GPs) turnover in England between 2007-2019, describe trends over time, regional differences and associations with social deprivation or other practice characteristics.

### Design

A retrospective study of annual cross-sectional data.

### Setting

All general practices in England (8,085 in 2007, 6,598 in 2019).

### Methods

We calculated turnover rates, defined as the proportion of GPs leaving a practice. Rates and their median, 25<sup>th</sup> and 75<sup>th</sup> percentiles were calculated by year and region. The proportion of practices with persistent high turnover (>10%) over consecutive years were also calculated. A negative binomial regression model assessed the association between turnover and social deprivation or other practice characteristics.

### Results

Turnover rates increased over time. The 75<sup>th</sup> percentile in 2009 was 11%, but increased to 14% in 2019. The highest turnover rate was observed in 2013-2014, corresponding to a 75<sup>th</sup> percentile of 18.2%. Over time, regions experienced increases in turnover rates, although it varied across English regions. A rise in the number of practices with persistent high turnover (>10%) for at least 3 consecutive years was also observed, from 2.7% (2.3% to 3.1%) in 2007 to 6.3% (5.7% to 6.9%) in 2017. The statistical analyses revealed that practice-area deprivation was moderately associated with turnover rate, with practices in the most deprived area having higher turnover rates compared to practices in the least deprived areas (IRR 1.0; 1.06 to 1.13).

### Conclusions

GP turnover has increased in the last decade nationally, with regional variability. Greater attention to physician turnover is needed, in the most deprived areas in particular, where GPs often need to

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3 deal with more complex health needs. There is a large cost associated with GP turnover and  
4 practices with very high persistent turnover need to be further researched, and the causes behind  
5 this identified, to allow support strategies and policies to be developed.  
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For peer review only

## Strengths and limitations of the study

This study uses two national datasets to quantify GP turnover rates in England between 2007-2019, describe their trends, regional distributions and their association with socio-economic deprivation and practice characteristics.

Quantifying GP turnover and understanding how it is distributed is fundamental to addressing challenges for the national health service, and for ensuring that quality and continuity of care are available to patients.

## Introduction

Primary care has a key role in the UK healthcare system, with general practitioners (GPs) the first point of contact for patient care. However, recent data have shown that the GP workforce in England is going through a major crisis,<sup>1</sup> reflected in increasing rates of early retirement and intentions to reduce hours of working or leave their practice in the near future.<sup>2</sup> Despite this being a common problem for other European countries<sup>3</sup> and globally,<sup>4</sup> it seems to be particularly serious for the UK.<sup>3,5</sup> According to an international survey of general practitioners from 2015, approximately 30% of GPs want to leave their profession within 5 years.<sup>3</sup>



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3 A 2019 report conducted by the Health Foundation highlighted that while there has been an  
4 increase in the number of hospital-based doctors, the number of GPs has reduced<sup>6</sup>; NHS staff  
5 retention has worsened since 2011/12 and, despite this being a government priority, there has  
6 been no improvement in retention in recent years.<sup>6</sup> Prior to the 2015 elections, the government  
7 promised 5,000 more doctors in primary care by 2020.<sup>7</sup> However, recent data from regional and  
8 national surveys indicate the number of full-time equivalent GPs per 1000 patients continues to  
9 decline. Regionally, GP surveys from West Midlands<sup>8</sup> and South West England<sup>9</sup> found that  
10 41.9% and 70% of participants intended to leave the practice or were likely or very likely to  
11 pursue a career choice that would negatively impact the GP workforce within the next 5 years,  
12 respectively. Likewise, the most recent national survey of 2,195 GPs in England conducted in  
13 2017 reported that 39% intended to leave 'direct patient care' within 5 years, compared with  
14 19.4% in 2005.<sup>2</sup>

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GP retention measures the percentage of staff staying in a practice for a defined period of time.  
GP turnover measures the proportion of staff who leave. Both are important indicators of the  
behaviour of doctors in the primary care workforce.<sup>6</sup> While retention is an indicator of the  
stability of a practice workforce, GP turnover is highly correlated with the desire to quit the  
profession, although this may in part be due to GPs retiring or simply moving practice.

Low retention or decreasing retention levels over time and high turnover rates are a major issue  
for NHS primary care. High GP turnover is a concern for several reasons: it may be associated  
with practices experiencing recurring problems with recruitment and retention<sup>10</sup>; it may affect the  
ability to deliver primary care services<sup>4</sup>; and undermine continuity of care which in turn may  
affect the quality of patient care. For instance, healthcare received from multiple GPs can lead to  
conflicting therapeutic treatments and fragmented care.<sup>11</sup> Conversely, the benefits of continuity  
of care has been documented in studies which linked greater continuity of care with higher  
patient satisfaction,<sup>12</sup> reduction in costs of care,<sup>13</sup> reduced risk of hospitalisation and lower  
mortality.<sup>14</sup> Differential turnover across practices and regions could also lead to a maldistribution  
of GPs, exacerbating retention problems<sup>10</sup> and health inequalities. It is also important to highlight  
that there is a large cost associated with GP turnover,<sup>15</sup> estimated to be 2 to 3 times the doctor's  
annual salary.<sup>16</sup> These costs include direct costs (separation costs, recruitment, induction and  
temporary replacement costs),<sup>17</sup> but also indirect or long term costs such as overwork by other

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3 staff plus the ‘costs’ in terms of quality of care. For instance, lower quality of care may lead to  
4 fewer patients seeking early diagnosis/treatments with long term costs for the NHS as a whole.  
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6 Lastly, GP turnover costs are likely to increase in the future due to the GP shortages which are  
7 linked but not necessarily are a consequence of turnover.  
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10 Despite existing concerns about retention and turnover levels in England, studies quantifying  
11 movements of the GP workforce are scarce with the most recent reporting data from the early  
12 90s.<sup>10</sup> Recently, Buchan et al (2019) in their report conclude that further research is required  
13 particularly to investigate actual turnover as opposed to intentions to leave.<sup>6 18</sup>  
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18 In England, detailed administrative data about the primary care workforce are collected and  
19 include practice-related characteristics as well as historical data on when a GP joins and leaves a  
20 practice. Compared to surveys, administrative data have the advantage that everyone is included  
21 rather than only the respondents and it is based on actual behaviour rather than intentions.  
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25 However, these data have rarely been used to quantify actual GP turnover rates.  
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28 In this study we used national data from NHS Digital, NHS Prescribing and the NHS  
29 Organisation Data Service to explore GP turnover rates over time and regionally, as well as to  
30 identify practice-level factors associated with them.  
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## 36 **Methods**

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38 The overall aim of the study was to explore turnover rates of GPs and look at trends in turnover  
39 in different regions over time in England between 2007-2019. In particular, the study aimed to: i)  
40 quantify rates of GP turnover in England, their trends over time, their differences across regions,  
41 and the predictors of GP turnover.  
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### 48 **Definition of GP turnover rates**

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50 With the aim of quantifying trends of GPs leaving general practices, turnover was defined as the  
51 number of GPs who leave a practice divided by the average of the number of GPs at the start and  
52 the number of GPs at the end of the year. This rate definition is similar to that used in previous  
53 studies on GPs turnover<sup>10 17</sup> and the current definition used by the NHS.<sup>19</sup>  
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$$\text{Turnover rate} = \frac{N \text{ GPs leaving a practice in a year}}{\text{Average number of GPs in a year}} \times 100$$

Where:

Average number of GPs in a year =  $(\text{GPs in a practice at the start of the year} + \text{GPs in a practice at the end of the year})/2$ ;

and

GPs in a practice at the end of the year =  $\text{Number of GPs at start of the year} + \text{Number of joiners} - \text{Number of leavers}$

Furthermore, with the aim of having a comprehensive picture on the movement of general practitioners, two additional measures were calculated: joiners' and retention rates, which describe i) the proportion of GPs who join a practice during the year; and, ii) the proportion of GPs who stay in a practice for entire year, respectively. Therefore, while retention indicates the ability of a practice to retain its staff, a high rate of joiners is likely to generate a high rate of turnover due to the association of low tenure with likelihood to quit. Rates and statistical analyses of turnover are presented in the main paper, whereas retention and joiners' rates are described and reported in the Supplementary Material Tables 1 and 2.

## Data sources

### GP workforce dataset

General practices are required to provide data about staff working at NHS practices or other primary care organisations in England. NHS Digital, previously the Health and Social Care Information Centre (HSCIC), regularly publishes workforce datasets which include information on individual GPs and practice level characteristics since 1995. These datasets are publicly available on the NHS Digital website<sup>20</sup>. This study used the annual datasets (September releases)

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3 between 2007 and 2020 and the files containing practice-level data containing all the information  
4 relative to a practice.  
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### 6 7 *Membership of practices*

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9 GPs in England are issued a code when they start prescribing, the GPs Primary General National  
10 Code (GNC), which is associated with their main prescribing cost centre and is issued by the  
11 NHS Prescription Services (NHS RxS). These codes are published by the NHS Organisation  
12 Data Service (ODS) on behalf of the NHS RxS. In particular, information about individual  
13 prescribing code of GPs (General National Code, GNC) and the date a GP has joined and left a  
14 practice, are included in the General Medical Practitioners data and the General Medical  
15 Practices, GPs-by-general practice data (GP membership-*epracmem*), respectively. In these data,  
16 each GP has an entry for every main prescribing cost centre (GP practice) where they have  
17 worked. Dates of when a GP joins and leaves a GP practice enables the calculation of GP  
18 turnover across a specified time window. These datasets include information only on those GPs  
19 who can prescribe i.e. GP partners and salaried GPs. These data are published free of charge and  
20 capture information on GP membership to each practice from 1974 and are updated weekly on  
21 the NHS Technology Reference data Update Distribution (TRUD)<sup>21</sup> website. Data on GP  
22 membership of practices were extracted on the second week of November 2020. Supplementary  
23 material Figure 1 summarises the data process.  
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### 38 **Study design and study population**

39 Practice-level GP workforce data were linked to the GPs-by-GPs practice data (*GP membership-*  
40 *epracmem*) using the practice code and each year included practices that were common in both  
41 data sources. The practice-level GP workforce files were used to identify practice characteristics  
42 and the GPs-by-GPs practice data (*GP membership-epracmem*) to calculate turnover rates  
43 combined for GP partners and salaried GPs given that these are the only GPs able to prescribe  
44 and whose information is included in the datasets. Joiners' and retention rates are described and  
45 reported in the Supplementary material Tables 1 and 2, respectively).  
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## Statistical analyses

Only practices with at least 750 registered patients were included in the analyses. Smaller practices were omitted (714, 8.1%, practices during the entire study window) as they could have been reducing patient numbers in preparation for closure which itself would affect GP turnover; or they could be newly formed practices which might have exhibited different recruiting behaviours. Finally, practices with no GPs left at the end of the year in question (because they were closing in the following years) were excluded from the analyses (2006, 22.8% practices during the entire time window). A table with the distribution of these practices and their turnover rates are provided in Supplementary Material Table 3.

### GP turnover rate over time and by NHS regions

Using the GPs-by-GPs practice data (*GP membership-eppracmem*), turnover rates were calculated for each practice and for every year in the study window (2007-2019). To summarise GP movement, the following analyses were performed. Firstly, summary statistics including mean (standard deviation, SD), 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> percentiles were calculated and violin plots produced. Violin plots are similar to box plots (including the median as a marker and a box indicating the interquartile range), but overlaid with the distribution of the data for better visualisation. Secondly, the proportion of practices with low, medium, high and very high turnover rate (equal to 0%, between 0% and <10%, between 10% and <40%, and  $\geq 40\%$ , respectively) were computed for every year. Although arbitrary, these thresholds were chosen to understand better the extent of turnover and whether there was a high proportion of practices with extreme values. Thirdly, the proportion of practices with persistent high turnover (>10%) across two, three, four, and five-years window was calculated with the intent to explore whether practice turnover might have indicated a temporary situation (2 or 3 years persistent high turnover) or a continuing problem (4 or 5 years persistent high turnover). Finally, turnover rates were produced at regional level using the most recent classification of NHS region and rates compared between 2007 versus 2019.

### Predictors of GP turnover rates

To identify factors influencing turnover, count data models were fitted to estimate incidence rate ratios (IRR) and 95% confidence intervals (CIs) of turnover rates. Specifically, a negative binomial distribution model was employed, this is the most appropriate model in the presence of

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3 overdispersion of the data. To explore the hypothesis that social deprivation of people living in  
4 the area where a practice was located is likely to increase turnover, the variables included in the  
5 primary model were average levels of deprivation where the practice was located (Index of  
6 Multiple Deprivation, IMD, 2015) categorised in quintiles and year in the study window. There  
7 was a small proportion of missing data for IMD (0.08%) in the main analysis and type of  
8 contract (0.30%) in the sensitivity analyses. For these variables, an extra category was included  
9 to indicate a missing value.

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16 Multiple sensitivity analyses were performed to test the robustness of the results. i) Restricting  
17 the analysis to practices active for the entire time-window to check whether opening or closing  
18 practices affected turnover rates. ii) Excluding from the analysis practices that had an Alternative  
19 Provider Medical Service (APMS) contract rather than those having a General Medical Service  
20 (GMS) or Personal Medical Service (PMS) contract. This allowed us to explore whether turnover  
21 rates were affected by the type of contract of a practice. iii) Fitting a random effect model with  
22 NHS region as random effect to understand whether regional variability influenced turnover  
23 rates. iv) Restricting the analysis to 2015-2019 given that more information was available for this  
24 time-window and it was possible to include additional variables in the model other than practice-  
25 area social deprivation (IMD 2015) and year. These variables were full-time-equivalent (FTE)  
26 per 1000 patients ratio and proportion of salaried GPs in the practice, which were included to  
27 explore whether GPs workload and practice network structure (with salaried GPs more likely to  
28 leave) were associated with levels of turnover.  
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## 42 **Patients and Public Involvement**

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44 Patients and public involvement (PPI) members were involved in the project. They did not  
45 contribute to the research question or study design, but provided feedback on the study findings.  
46 In particular, a forum group was organised with five PPI members. They agreed that GPs leaving  
47 a practice had a negative influence on patients' quality and continuity of care. They highlighted  
48 the following points regarding the potential disruption of their relationship with their GP: lack of  
49 communication and feeling apprehensive when they had to meet a new or different GP. Overall a  
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3 personal relationship with the GP was very important, although often practices did not meet  
4 patients' expectations.  
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## 7 8 **Results**

### 9 10 GP turnover rates and their trends over time and by NHS region

11 After merging the GP workforce data with the GPs-by-GPs practice data (*GP membership-*  
12 *epracmem*), the number of practices included in the analyses decreased during the study window,  
13 from 8,085 practices in 2007 to 6,598 in 2019 (Table 1). Supplementary material Figure 1  
14 summarises the data process.  
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18 Overall, half of the practices had a zero turnover rate within each year of analysis. Over time,  
19 turnover rates increased during the study window; in particular, in 2009, the 75<sup>th</sup> percentile  
20 corresponded to an 11% rate and this had increased to 14% in 2019. However, the increase was  
21 not linear as the peak occurred in 2013-2014 when the 75<sup>th</sup> percentile of turnover corresponded  
22 to 18%. Summary statistics for turnover rates over time are reported in Table 1 and by violin  
23 plots in Supplementary Figure 2).  
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27 Between 2007 and 2019 the proportion of practices with low turnover (equal to 0%, meaning that  
28 no GP left the practice that year) decreased from 79% (in 2007) to 61% (in 2019), whereas the  
29 proportion of practices with medium turnover rates (below 10%) slightly increased from 1% in  
30 2007 to 5% in 2009. Overall, 14% of the practices had high turnover (corresponding to 10%-  
31 40%) in 2007 a share that increased to 27% in 2019. Approximately 8% of the practices showed  
32 very high turnover (above 40%) during the entire time window (Table 2 and Figure 1).  
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36 Turnover rates showed great variation across regions. When regional turnover rates were  
37 compared at the beginning and end of the study window, all the NHS regions had an increase in  
38 turnover rates (2007 vs 2019) (Figure 2). NHS England Midlands and East (West Midlands) had  
39 the largest increase in turnover rate (on average 6%), varying from 6% in 2007 to 12% in 2019;  
40 whereas NHS England Lancashire and South Cumbria had nearly no increase in turnover (on  
41 average 0%) (Figure 2). For all the regions, trends of turnover were not always consistently  
42 increasing but demonstrated peaks around 2013-2014.  
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46 Finally, when examining persistent high turnover over time (>10%), findings revealed that,  
47 between 2007 and 2013, there had been a steady increase in the proportion of practices with  
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3 persistent high turnover either for 2-3 consecutive years (temporary situation) or for 4-5  
4 consecutive years (continuing problem). Practices with high turnover over two years, for  
5 example, increased from 6.0% in 2007 to 17.6% in 2013, before decreasing to 14.4% in 2018  
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7 (Figure 3 and Supplementary Table 4).  
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### 10 *Predictors of GPs turnover*

11 The statistical analyses investigating predictors of GPs turnover revealed that area-deprivation of  
12 a practice and year were associated with turnover rate. In particular, practices in the most  
13 deprived locations had a greater risk of higher turnover compared to practices in the least  
14 deprived areas (IRR 1.09; 1.06 to 1.13); and every year in the study window was associated with  
15 an increasing turnover rate compared to 2007 (Table 3), with 2013 and 2014 associated with the  
16 highest turnover rates compared to 2007 (IRR 1.67; 1.59 to 1.77 and IRR 1.74; 1.64 to 1.83)  
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18 (Table 3) and Figure 4.  
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### 28 *Sensitivity analyses*

29 Results from sensitivity analyses confirmed the main findings. This was the case when the  
30 analysis was restricted to practices active for the entire time window; or when practices with  
31 APMS contract were excluded; or when a random effect model for NHS region was fitted (Table  
32 4). When the time-window included only practices between 2015 and 2019 and additional  
33 variables were included in the statistical model, area-practice deprivation (IRR 1.08; 1.02 to  
34 1.13, practices located in most deprived areas vs least deprived areas), proportion of salaried GPs  
35 (IRR 1.69; 1.59 to 1.79), and year 2018 compared to 2015 (IRR 1.12; 1.07 to 1.18) were all  
36 significantly associated with higher turnover; whereas lower workload, as expressed by the FTE  
37 per 1,000 patients ratio, was associated with lower turnover rate (IRR 0.84; 0.78 to 0.90) (Table  
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## 50 **Discussion**

### 51 **Main findings**

52 For the first time, rather than intention to leave, this study describes levels of GPs turnover over  
53 a 12-year window (2007-2019) and its variation by geographical regions in English primary care.  
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3 In addition, it also reports on practice-area social deprivation and practice staffing relative to  
4 patient lists that were associated with higher or lower levels of GPs turnover, respectively.  
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7 Findings revealed that turnover rates were increasing over time, although overall changes were  
8 small. Interestingly, turnover rates were the highest during 2013-2014. Over time, the proportion  
9 of practices with high turnover increased by 13% and those with very high turnover remained at  
10 the same level (around 8%). The majority of NHS regions experienced a rise in turnover between  
11 2007 and 2019, which was greater in some regions than others. For instance, NHS England West  
12 Midlands was the region worst affected. Results also showed that, across the entire time window,  
13 there was a rising number of practices with persistent high turnover for at least five consecutive  
14 years, indicative of a continuing problem for these practices. However, this was not associated  
15 with practice-level deprivation (results not shown). Finally, there was a significant association  
16 between practice area social deprivation and levels of turnover rates. Specifically, practices  
17 located in most deprived areas were associated with the likelihood of higher GP turnover  
18 compared to practices located in least deprived areas.  
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### 29 **Strengths and limitations of the study**

30 The study has several strengths. First, it quantified and described GPs' actual turnover rather  
31 than "intentions to leave" usually reported in existing studies.<sup>2 22</sup> Second, it used two national  
32 administrative datasets, regularly updated and monitored by NHS Digital and the NHS  
33 Prescription Service (RXS)/NHS Organisation Data Service, which have the advantage of  
34 including everyone rather than only respondents to a survey, therefore they might be less prone  
35 to bias. Third, the study provided rates for a 12-year window and across regions of England.  
36 Fourth, the approach employed to calculate turnover rates, used the exact dates when a GP joined  
37 and left a practice, therefore more accurate than using aggregate data.<sup>10</sup> Fifth, it presented  
38 methodological advances in combining multiple data sources containing information about the  
39 primary care workforce and historical data of individual GPs' characteristics.  
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48 Limitations of the study need to be acknowledged as well. Despite the fact the workforce data  
49 provide a wealth of information on practices characteristics, the main analyses performed in the  
50 study included only basic variables (such as practice area social deprivation and year). This was  
51 due to NHS Digital employing a revised methodology to calculate some variables (such as GPs'  
52 FTE) from 2015, therefore these data are not comparable with previous years. In addition, it was  
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not possible to have detailed information on individual GP demographics (age and gender) and their employment model from the GP workforce datasets, therefore all the rates presented are combined for GP partners and salaried GPs. Confidence intervals for the proportions are not reported since the sample is large and there is very little uncertainty around the estimates. Hence, these would add complexity but little to no new information. Finally, it was not possible to distinguish between those GPs who moved to a different practice, retired or left primary care completely. Nevertheless, joiners' and retention rates have also been provided (in the Supplementary material) to give a comprehensive description of the GPs workforce behaviour of joining, staying or leaving a practice.

### **Comparison with other studies**

Studies examining GP turnover rates in England are scarce and relate to the early 90s.<sup>10 23</sup> Compared to Taylor *et al.*,<sup>10</sup> turnover rates are slightly higher in our study, but this can be attributed to the different time-window analysed or to differences in the methodology used, such as combining multiple data sources, using the exact date a GP has joined or left a practice, and including all types of working patterns rather than those GPs practicing full time only.<sup>10</sup> Similar to their findings is the variation of turnover by region and its association with social deprivation.<sup>10</sup> Increasing turnover and regional variation have also been found across NHS Trusts in England for other healthcare professionals.<sup>24</sup>

### **Interpretation of findings and implication for practice**

Findings from our study have revealed that there was an increase in GP turnover over the last decade. This trend might be explained by a rising number of GPs intending to leave their profession or having a career break,<sup>2 22</sup> with several factors contributing to this intention, such as increasing workload, burnout,<sup>25</sup> lack of or reduced job satisfaction,<sup>8 22</sup> and dissatisfaction with the "amount of responsibility given",<sup>2</sup> "physical working conditions"<sup>2</sup> and time spent on "unimportant tasks"<sup>8</sup>. The reasons behind the peak of turnover in 2013-2014 are unclear; this coincides with, but on investigation did not appear to be due to the introduction of the APMS contract of the practices.

Existing literature highlights that GPs often find managing patients in areas of socioeconomic deprivation a challenge due to the higher prevalence of multimorbidity and the associated healthcare needs.<sup>26-28</sup> The higher turnover rates observed in more deprived areas might also be

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3 related to differences in the distribution of GP or other healthcare professional workforce, though  
4 it is difficult to determine whether these differences are the cause or consequence of higher GP  
5 turnover.  
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9 Regional variations in turnover might be due to different levels of social deprivation across the  
10 regions and varying health services' pressures. Whereas, the persistent high turnover experience  
11 by a number of practices, indicative of a continuing and unresolved problem within the practice  
12 or area rather than temporary situation, might be associated with practices experiencing problems  
13 with recruitment and retention for specific reasons.<sup>10</sup>  
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18 High GP turnover is a concern for the entire healthcare system. Recently, the ReGROUP project  
19 concluded that policies and strategies to address the existing healthcare workforce crisis in  
20 primary care and maximise retention of GPs should facilitate sustainable GP workload and  
21 contractual requirements, as well as the need for personal and professional support; in addition to  
22 target areas which influence job satisfaction and work-life balance.<sup>29</sup>  
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## 28 **Conclusions**

29 Our findings suggest that GP turnover has increased in the last decade across the whole of  
30 England, supporting previous local investigations and national surveys. Greater attention to  
31 physician turnover is needed, particularly in the most severely deprived areas, to address the  
32 complex health needs of the population living in these areas and avoid the exacerbation of health  
33 inequalities. Moreover, there is a large cost associated with GP turnover and practices with very  
34 high persistent turnover need to be further investigated. Finally, targeted policies and strategies  
35 need to be developed and tested to diminish its occurrence.  
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## 45 **Contributors**

46 RP, EK and YSL led on the study design, planned and performed the statistical analyses. RP  
47 wrote the first draft of the manuscript. SG and RP organised the PPI event. All authors  
48 contributed to the interpretation of the findings and the final draft of the paper. RP is the  
49 guarantor. The corresponding author attests that all listed authors meet authorship criteria and no  
50 others meeting the criteria have been omitted.  
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All decisions concerning analysis, interpretation, and publication are made independently from the funder.

## Competing interests

All authors declare no competing interests.

## Ethical Approval

Not required.

## Data sharing

The GP workforce and the GPs-by-general practices data are freely available from the NHS Digital and TRUD websites, respectively.

## Author's statement

The lead author affirms that the manuscript is an honest, transparent account, of the study being reported; and that no important aspects have been omitted; and that any discrepancy from the study as planned have been explained.

## References

1. RCGP. New league table reveals GP shortages across England, as patients set to wait week or more to see family doctor on 67 m occasions (Accessed 22.7.2020). 2015.
2. Gibson J, Sutton M, Spooner S, Checkland K. Ninth National GP Worklife Survey: University of Manchester: Policy Research Unit in Commissioning and the Healthcare System Manchester Centre for Health Economics, 2018.

3. Martin S, Davies E, Gershlick B. Under pressure: What the Commonwealth Fund's 2015 international survey of general practitioners means for the UK. London: The Health Foundation, 2016.
4. Shen X, Jiang H, Xu H, Ye J, Lv C, Lu Z, et al. The global prevalence of turnover intention among general practitioners: a systematic review and meta-analysis. *BMC Family Practice* 2020;21(1):246.
5. Hayes H, Gibson J, Fitzpatrick B, Checkland K, Guthrie B, Sutton M, et al. Working lives of GPs in Scotland and England: cross-sectional analysis of national surveys. *BMJ Open* 2020;10(10):e042236.
6. Buchan J, Charlesworth A, Gershlick B, Seccombe I. A critical moment: NHS staffing trends, retention and attrition: The Health Foundation, 2019.
7. Hunt J. New deal for general practice. Jeremy Hunt sets out the first steps in a new deal for GPs. 2015.
8. Dale J, Potter R, Owen K, Parsons N, Realpe A, Leach J. Retaining the general practitioner workforce in England: what matters to GPs? A cross-sectional study. *BMC Family Practice* 2015;16(1):140.
9. Fletcher E, Abel GA, Anderson R, Richards SH, Salisbury C, Dean SG, et al. Quitting patient care and career break intentions among general practitioners in South West England: findings of a census survey of general practitioners. *BMJ Open* 2017;7(4):e015853.
10. Taylor DH, Jr., Leese B. General practitioner turnover and migration in England 1990-94. *Br J Gen Pract* 1998;48(428):1070-72.
11. Reddy A, Pollack CE, Asch DA, Canamucio A, Werner RM. The Effect of Primary Care Provider Turnover on Patient Experience of Care and Ambulatory Quality of Care. *JAMA Internal Medicine* 2015;175(7):1157-62.
12. Fan VS, Burman M, McDonell MB, Fihn SD. Continuity of care and other determinants of patient satisfaction with primary care. *J Gen Intern Med* 2005;20(3):226-33.
13. Hussey PS, Schneider EC, Rudin RS, Fox DS, Lai J, Pollack CE. Continuity and the Costs of Care for Chronic Disease. *JAMA Internal Medicine* 2014;174(5):742-48.
14. Nyweide DJ, Anthony DL, Bynum JPW, Strawderman RL, Weeks WB, Casalino LP, et al. Continuity of Care and the Risk of Preventable Hospitalization in Older Adults. *JAMA Internal Medicine* 2013;173(20):1879-85.
15. Buchbinder S, Wilson M, Melick C, Powe N. Primary care physician job satisfaction and turnover. *Am J Manag Care* 2001;7(7):701-13.
16. Shanafelt T, Goh J, Sinsky C. The Business Case for Investing in Physician Well-being. *JAMA Internal Medicine* 2017;177(12):1826-32.
17. Buchan J. Reviewing The Benefits of Health Workforce Stability. *Human Resources for Health* 2010;8(1):29.
18. Hann M, Reeves D, Sibbald B. Relationships between job satisfaction, intentions to leave family practice and actually leaving among family physicians in England. *European Journal of Public Health* 2010;21(4):499-503.
19. NHS Digital. Joiners and leaver rates with stability index 2016 -2018. <https://digital.nhs.uk/data-and-information/find-data-and-publications/supplementary-information/2019-supplementary-information-files/leavers-and-joiners/joiners-and-leaver-rates-with-stability-index-2016---2018>, 2019.

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20. NHS Digital. General Practice Workforce. <https://digital.nhs.uk/data-and-information/publications/statistical/general-and-personal-medical-services>.
  21. NHS Digital TRUD. NHS ODS weekly prescribing-related data. <https://isd.digital.nhs.uk/trud3/user/guest/group/0/pack/5>
  22. Gibson J, Checkland K, Coleman A, Hann M, McCall R, Spooner S, et al. Eighth National GP Worklife Survey: Policy Research Unit in Commissioning and the Healthcare System Manchester Centre for Health Economics. Manchester. <<http://www.population-health.manchester.ac.uk/healthconomics/research/Reports/EighthNationalGPWorklifeSurveyreport>>, 2015.
  23. Taylor DH, Jr., Brenda L. Recruitment, retention, and time commitment change of general practitioners in England and wales, 1990-4: a retrospective study. *BMJ* 1997;314(1806).
  24. Buchan J, Charlesworth A, Gershlick B, Seccombe I. Rising pressure: the NHS workforce challenge: The Health Foundation, 2017.
  25. Cheshire A, Ridge D, Hughes J, Peters D, Panagioti M, Simon C, et al. Influences on GP coping and resilience: a qualitative study in primary care. *British Journal of General Practice* 2017;67(659):e428-e36.
  26. Eley E, Jackson B, Burton C, Walton E. Professional resilience in GPs working in areas of socioeconomic deprivation: a qualitative study in primary care. *British Journal of General Practice* 2018;68(677):e819.
  27. O'Brien R, Wyke S, Guthrie B, Watt G, Mercer S. An 'endless struggle': a qualitative study of general practitioners' and practice nurses' experiences of managing multimorbidity in socio-economically deprived areas of Scotland. *Chronic Illn* 2011;7(1):45-59.
  28. Long L, Moore D, Robinson S, Sansom A, Aylward A, Fletcher E, et al. Understanding why primary care doctors leave direct patient care: a systematic review of qualitative research. *BMJ Open* 2020;10(5):e029846.
  29. Chilvers R, Richards SH, Fletcher E, Aylward A, Dean S, Salisbury C, et al. Identifying policies and strategies for general practitioner retention in direct patient care in the United Kingdom: a RAND/UCLA appropriateness method panel study. *BMC Family Practice* 2019;20(1):130.

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**Table 1. GP turnover rates between 2007 and 2019.**

year	N practices	Mean	SD	Median	IQR	25th percentile	75th percentile
2007	8085	6.9	18.0	0.0	0.0	0.0	0.0
2008	8053	7.5	18.2	0.0	0.0	0.0	0.0
2009	8077	9.2	20.3	0.0	11.1	0.0	11.1
2010	8058	9.4	20.0	0.0	11.8	0.0	11.8
2011	8009	10.5	20.8	0.0	15.4	0.0	15.4

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3	2012	7924	10.8	20.2	0.0	16.7	0.0	16.7	
4	2013	7809	11.6	19.3	0.0	18.2	0.0	18.2	
5	2014	7629	12.0	19.9	0.0	18.2	0.0	18.2	
6	2015	7404	9.4	17.4	0.0	14.5	0.0	14.5	
7	2016	7211	9.4	18.0	0.0	14.3	0.0	14.3	
8	2017	6963	9.6	17.2	0.0	15.4	0.0	15.4	
9	2018	6757	10.3	17.0	0.0	16.7	0.0	16.7	
10	2019	6598	9.1	16.0	0.0	14.3	0.0	14.3	
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**Table 2 Proportion of practices with low, medium, high and very high turnover rates over time.**

Year	N practices	N practices with low turnover	% of practices with low turnover	N practices with medium turnover	% of practices with medium turnover	N practices with high turnover	% of practices with high turnover	N practices with very high turnover	% of practices with very high turnover
2007	8075	6419	79.5	71	0.9	1104	13.7	481	5.96
2008	8053	6208	77.1	95	1.2	1201	14.9	549	6.82

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3	2009	8077	5850	72.4	117	1.4	1448	17.9	662	8.20
4	2010	8056	5817	72.2	107	1.3	1453	18.0	679	8.43
5	2011	8008	5538	69.2	90	1.1	1588	19.8	792	9.89
6	2012	7924	5218	65.9	127	1.6	1858	23.4	721	9.10
7	2013	7808	4713	60.4	192	2.5	2171	27.8	732	9.38
8	2014	7629	4482	58.7	199	2.6	2200	28.8	748	9.80
9	2015	7404	4809	65.0	217	2.9	1863	25.2	515	6.96
10	2016	7211	4647	64.4	256	3.6	1811	25.1	497	6.89
11	2017	6963	4359	62.6	257	3.7	1884	27.1	463	6.65
12	2018	6757	3975	58.8	310	4.6	2016	29.8	456	6.75
13	2019	6597	4049	61.4	355	5.4	1808	27.4	385	5.84
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**Table 3 Predictors of GP turnover rates (primary analysis)**

	IRR (95% CIs)	p-value
<b>IMD</b>		
<b>1 (least deprived)</b>	Reference	
<b>2</b>	1.01 (0.98-1.05)	0.368
<b>3</b>	1.08 (1.04-1.11)	0.000
<b>4</b>	1.09 (1.06-1.13)	0.000
<b>5 (most deprived)</b>	1.12 (1.08-1.16)	0.000
<b>2007</b>	Reference	
<b>2008</b>	1.08 (1.02-1.15)	0.011
<b>2009</b>	1.33 (1.26-1.41)	0.000
<b>2010</b>	1.37 (1.29-1.45)	0.000



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3	<b>2011</b>	1.54 (1.46-1.63)	0.000
4	<b>2012</b>	1.56 (1.48-1.65)	0.000
5	<b>2013</b>	1.67 (1.59-1.77)	0.000
6	<b>2014</b>	1.74 (1.64-1.83)	0.000
7	<b>2015</b>	1.33 (1.26-1.41)	0.000
8	<b>2016</b>	1.34 (1.26-1.41)	0.000
9	<b>2017</b>	1.39 (1.31-1.47)	0.000
10	<b>2018</b>	1.49 (1.41-1.58)	0.000
11	<b>2019</b>	1.31 (1.24-1.39)	0.000
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**Table 4 Sensitivity analyses. Predictors of GP turnover rates: i) restricting the analysis to practices active for the entire time-window; ii) excluding practices with APMS contract; iii) random-effect model with NHS region as random effect.**

	Practice active for the entire time-window		Excluding practices with APMS contract		Random-effect model with NHS region as random effect	
	IRR (95% CIs)	p-value	IRR (95% CIs)	p-value	IRR (95% CIs)	p-value
<b>IMD</b>						
<b>1 (least deprived)</b>	Reference					
<b>2</b>	1.01 (0.98-1.05)	0.386	1.02 (0.99-1.05)	0.254	1.02 (0.95-1.09)	0.583
<b>3</b>	1.07 (1.04-1.11)	0.000	1.07 (1.04-1.11)	0.000	1.07 (1.01-1.15)	0.031
<b>4</b>	1.08 (1.05-1.12)	0.000	1.09 (1.06-1.13)	0.000	1.09 (1.02-1.17)	0.007

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3	<b>5 (most deprived)</b>	1.09 (1.06-1.13)	0.000	1.11 (1.08-1.15)	0.000	1.10 (1.03-1.18)	0.004
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5	<b>2007</b>	Reference					
6	<b>2008</b>	1.06 (0.99-1.12)	0.080	1.08 (1.01-1.14)	0.015	1.09 (0.97-1.22)	0.140
7	<b>2009</b>	1.31 (1.23-1.39)	0.000	1.33 (1.26-1.41)	0.000	1.34 (1.20-1.50)	0.000
8	<b>2010</b>	1.35 (1.27-1.43)	0.000	1.35 (1.28-1.43)	0.000	1.36 (1.22-1.52)	0.000
9	<b>2011</b>	1.53 (1.44-1.62)	0.000	1.52 (1.44-1.61)	0.000	1.53 (1.37-1.70)	0.000
10	<b>2012</b>	1.56 (1.47-1.65)	0.000	1.55 (1.46-1.64)	0.000	1.57 (1.41-1.74)	0.000
11	<b>2013</b>	1.65 (1.56-1.75)	0.000	1.65 (1.57-1.75)	0.000	1.68 (1.51-1.86)	0.000
12	<b>2014</b>	1.70 (1.61-1.80)	0.000	1.73 (1.63-1.82)	0.000	1.74 (1.56-1.93)	0.000
13	<b>2015</b>	1.31 (1.23-1.39)	0.000	1.31 (1.24-1.39)	0.000	1.37 (1.22-1.53)	0.000
14	<b>2016</b>	1.31 (1.24-1.39)	0.000	1.31 (1.24-1.39)	0.000	1.37 (1.22-1.53)	0.000
15	<b>2017</b>	1.40 (1.32-1.48)	0.000	1.39 (1.31-1.47)	0.000	1.40 (1.25-1.57)	0.000
16	<b>2018</b>	1.53 (1.44-1.61)	0.000	1.49 (1.41-1.57)	0.000	1.49 (1.34-1.67)	0.000
17	<b>2019</b>	1.33 (1.26-1.41)	0.000	1.31 (1.23-1.38)	0.000	1.33 (1.18-1.49)	0.000
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**Table 5 Sensitivity analyses. Predictors of GPs turnover restricting the time-window to 2015-2019 and adding “proportion of salaried GPs” and “FTE per 1000 patients ratio” to the model**

	IRR (95% CIs)	p-value
<b>IMD</b>		
<b>1 (least deprived)</b>	Reference	
<b>2</b>	1.05 (1.00-1.10)	0.063
<b>3</b>	1.06 (1.01-1.12)	0.012
<b>4</b>	1.06 (1.01-1.12)	0.013
<b>5 (most deprived)</b>	1.08 (1.02-1.13)	0.004
<b>Proportion of salaried GPs</b>	1.69 (1.59-1.79)	0.000
<b>FTE per 1000 patients ratio</b>	0.84 (0.78-0.90)	0.000

	<b>2015</b>	Reference	
	<b>2016</b>	0.99 (0.95-1.05)	0.845
	<b>2017</b>	1.03 (0.98-1.09)	0.215
	<b>2018</b>	1.12 (1.07-1.18)	0.000
	<b>2019</b>	0.98 (0.93-1.03)	0.504

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**Figure 1 Proportion of practices with low, medium, high and very high turnover over time.**

Note: The proportion of practices on y-axis has not been multiplied by 100.

**Figure 2 Comparison of GPs turnover rate according to NHS region 2007 vs 2019.**

Note: The proportion of practices on y-axis has not been multiplied by 100.

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3 **Figure 3 Proportion of practices with persistent high turnover rates ( $\geq 10\%$ ) over 2, 3, 4**  
4 **and 5-year window)**  
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6 Note: The proportion of practices on y-axis has not been multiplied by 100.  
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10 **Figure 4 Predicted probabilities of GP turnover according to quantiles of social deprivation**  
11 **(IMD, 2015) and year**  
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13 Note: The proportion of practices on y-axis has not been multiplied by 100.  
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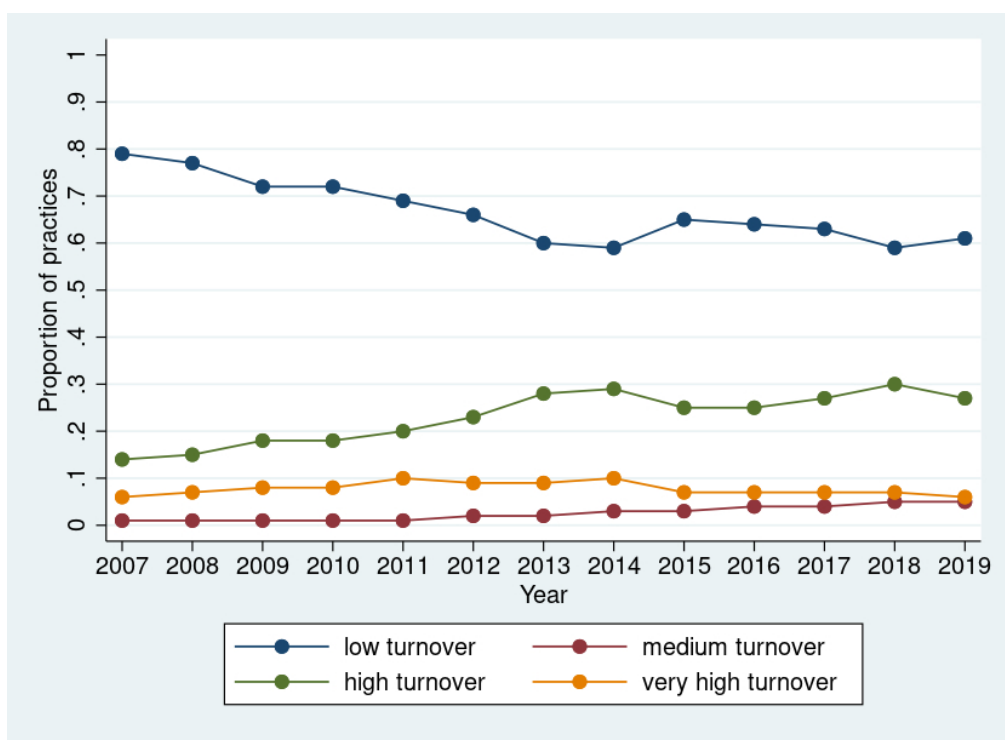


Figure 1 Proportion of practices with low, medium, high and very high turnover over time.

291x211mm (72 x 72 DPI)

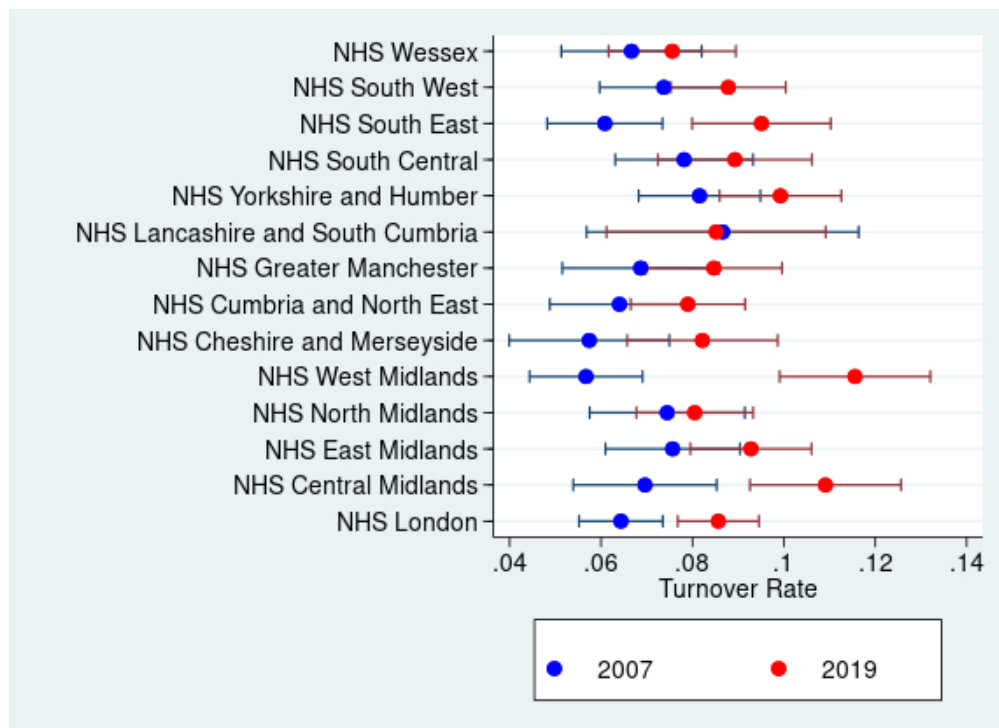


Figure 2 Comparison of GPs turnover rate according to NHS region 2007 vs 2019.

201x146mm (72 x 72 DPI)

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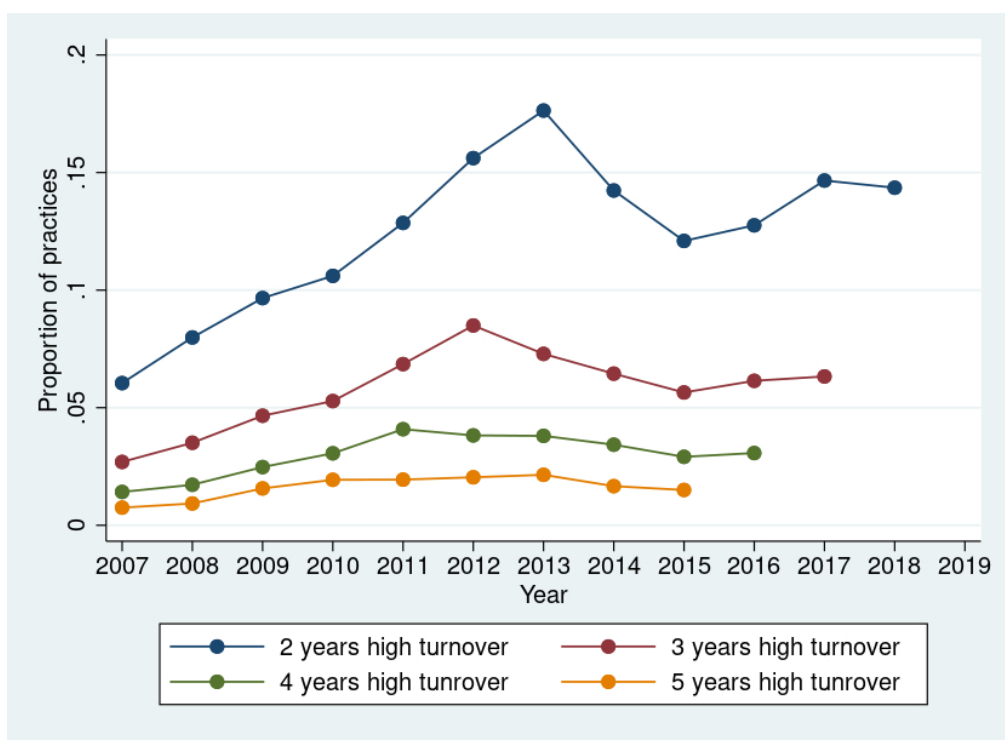


Figure 3 Proportion of practices with persistent high turnover rates ( $\geq 10\%$ ) over 2, 3, 4 and 5-year window)

291x211mm (72 x 72 DPI)



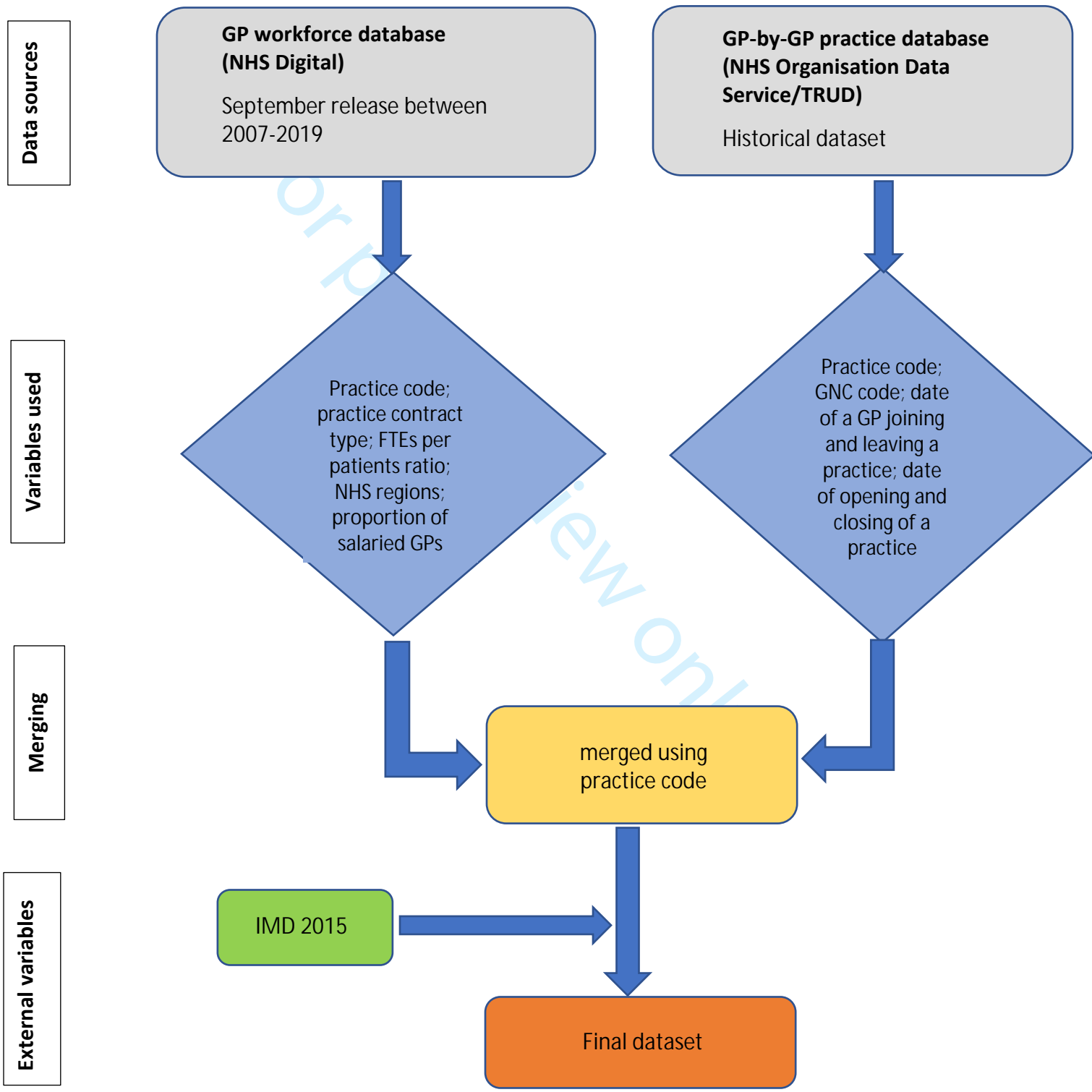
Figure 4 Predicted probabilities of GP turnover according to quantiles of social deprivation (IMD, 2015) and year

206x149mm (72 x 72 DPI)

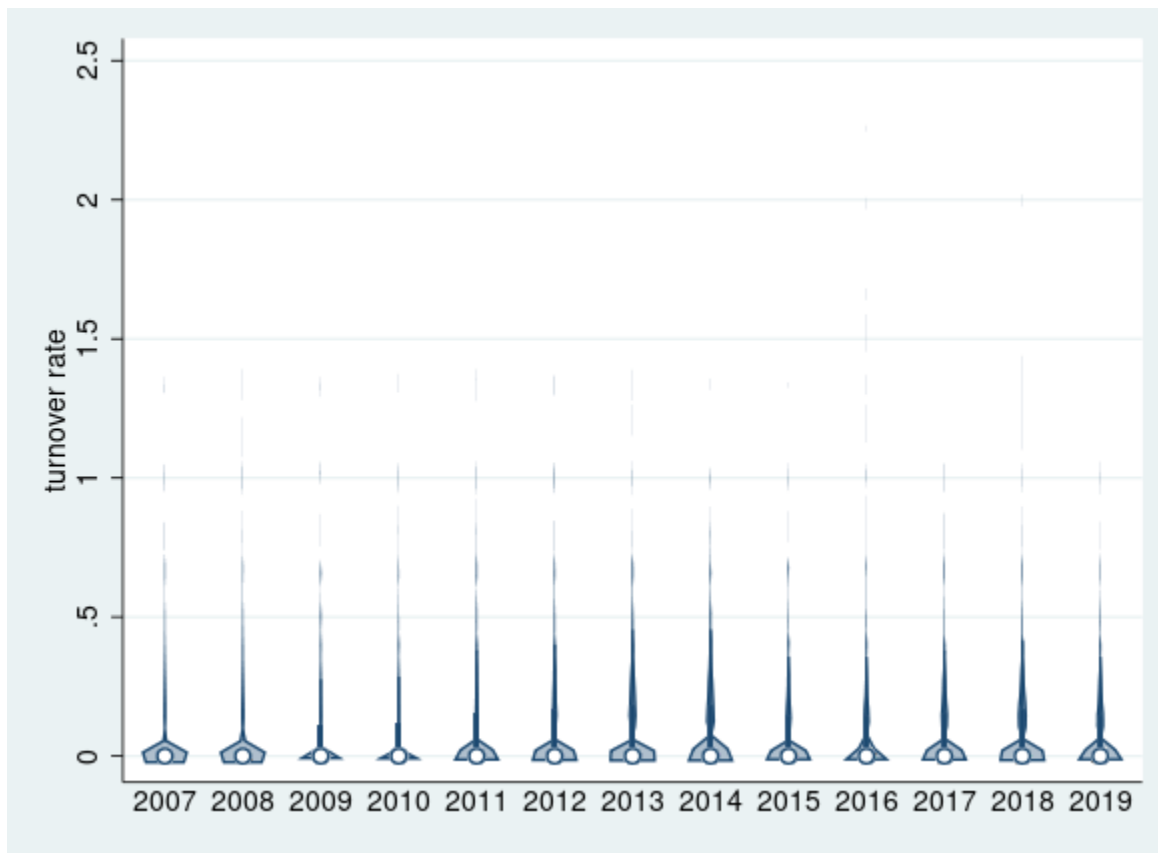


Supplementary material for “Rates of turnover among general practitioners in England between 2007-2019: a retrospective study”.

Supplementary Figure 1: Flow chart showing the data process



Supplementary Figure 2: Violin plot for general practitioner (GP) turnover rates between 2007 and 2019



Note: Turnover rate on the y-axis have not been multiplied by 100.

## GP Joiners' and retention rates

### Definition of GP joiners' and retention rates

Two additional measures were calculated in order to quantify trends of general practitioners (GPs) and their attitude in leaving general practices, joiners' and retention rates, which describe the proportion of GPs who join a practice during the year and the proportion of GPs who stay in a practice for entire year, respectively.

The following definitions of GPs joiners' rates were used:

$$\text{Joiners' rate} = \frac{\text{GPs in a practice who join during the year}}{\text{*Average number of GPs during the year}} \times 100$$

Where:

Average number of GPs in a year= *(GPs in a practice at the start of the year + GPs in a practice at the end of the year)/2*; and

GPs in a practice at the end of the year= *Number of GPs at start of the year + Number of joiners – Number of leavers*

The following definitions of GPs retention rates was used. Retention did not account for GPs who may join during the year.

$$\text{Retention rate} = \frac{\text{GPs in a practice who stay the entire year}}{\text{GPs at the start of the year}} \times 100$$

**Supplementary Table 1. GP joiners' rate between 2007 and 2019.**

year	N practices	Mean	SD	Median	IQR	25th percentile	75th percentile
2007	8085	9.4	20.3	0.0	12.5	0.0	12.5
2008	8053	9.4	20.0	0.0	11.8	0.0	11.8
2009	8077	10.7	21.6	0.0	15.4	0.0	15.4
2010	8058	11.1	21.2	0.0	16.7	0.0	16.7
2011	8009	11.8	21.4	0.0	18.2	0.0	18.2
2012	7924	13.2	21.9	0.0	20.0	0.0	20.0
2013	7809	15.0	23.3	0.0	23.5	0.0	23.5
2014	7629	13.7	22.3	0.0	22.2	0.0	22.2
2015	7404	11.1	20.6	0.0	16.0	0.0	16.0
2016	7211	11.6	19.7	0.0	18.2	0.0	18.2
2017	6963	12.3	20.2	0.0	18.2	0.0	18.2
2018	6757	13.6	20.6	0.0	21.4	0.0	21.4
2019	6598	11.4	18.9	0.0	18.2	0.0	18.2

**Supplementary Table 2: GP retention rates between 2007 and 2019.**

Year	N practices	Mean	SD	Median	IQR	25th percentile	75th percentile
2007	8075	94.7	13.9	100.0	0.0	100.0	100.0
2008	8053	94.2	14.1	100.0	0.0	100.0	100.0
2009	8077	93.0	15.5	100.0	0.0	100.0	100.0
2010	8056	93.0	15.3	100.0	0.0	100.0	100.0
2011	8008	92.1	15.8	100.0	11.1	88.9	100.0
2012	7924	91.6	16.0	100.0	14.3	85.7	100.0
2013	7808	91.1	15.1	100.0	16.2	83.8	100.0
2014	7629	90.8	15.2	100.0	16.7	83.3	100.0
2015	7404	92.3	14.4	100.0	12.5	87.5	100.0
2016	7211	92.5	14.4	100.0	12.5	87.5	100.0
2017	6963	92.3	13.9	100.0	12.5	87.5	100.0
2018	6757	92.0	13.4	100.0	14.3	85.7	100.0
2019	6597	92.5	13.0	100.0	12.5	87.5	100.0

**Supplementary Table 3: Number of practices excluded and distribution of general practitioner (GP) turnover rates**

Year	N practices excluded	N practices where turnover was not missing	Mean	SD	Median	IQR	25th percentile	75th percentile
2007	118	113	166.4	126.7	200.0	150.0	50.0	200.0
2008	177	169	127.5	118.0	200.0	200.0	0.0	200.0
2009	222	201	115.9	129.8	100.0	200.0	0.0	200.0
2010	265	253	111.5	113.0	66.7	200.0	0.0	200.0
2011	299	222	125.7	130.7	200.0	200.0	0.0	200.0
2012	164	155	163.9	177.0	200.0	200.0	0.0	200.0
2013	153	144	204.0	201.7	200.0	0.0	200.0	200.0
2014	244	222	199.8	143.0	200.0	0.0	200.0	200.0
2015	219	204	233.6	151.0	200.0	0.0	200.0	200.0
2016	345	274	195.7	79.8	200.0	0.0	200.0	200.0
2017	391	283	217.3	260.4	200.0	0.0	200.0	200.0
2018	369	221	208.8	92.9	200.0	0.0	200.0	200.0
2019	269	182	196.2	72.4	200.0	0.0	200.0	200.0

**Supplementary Table 4: Persistent high turnover (>10%) over 2, 3, 4, or 5 consecutive years.**

Year	N pract active 2 years	N prac persist high turnover 2 years	% prop prac persist high turnover 2 years	N pract active 3 years	N prac persist high turnover 3 years	% prop prac persist high turnover 3 years	N pract active 4 years	N prac persist high turnover 4 years	% prop prac persist high turnover 4 years	N pract active 5 years	N prac persist high turnover 5 years	% prop prac persist high turnover 5 years
2007	7906	478	6.0	7798	210	2.7	7691	109	1.4	7601	57	0.7
2008	7862	628	8.0	7753	272	3.5	7664	132	1.7	7550	70	0.9
2009	7845	758	9.7	7749	361	4.7	7633	189	2.5	7463	117	1.6
2010	7845	832	10.6	7725	408	5.3	7547	231	3.1	7345	142	1.9
2011	7785	1001	12.9	7601	521	6.9	7392	302	4.1	7158	139	1.9
2012	7615	1189	15.6	7404	629	8.5	7170	274	3.8	6911	141	2.0
2013	7411	1307	17.6	7175	523	7.3	6917	263	3.8	6711	144	2.1
2014	7178	1022	14.2	6917	446	6.4	6712	230	3.4	6548	109	1.7
2015	6897	834	12.1	6692	378	5.6	6527	190	2.9	6527	98	1.5
2016	6742	860	12.8	6576	404	6.1	6576	202	3.1			
2017	6589	966	14.7	6589	417	6.3						
2018	6590	946	14.4									
2019												

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	
Objectives	3	State specific objectives, including any prespecified hypotheses	
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	p7 p9-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	p8
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	

1	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	p12
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4	<b>Discussion</b>			
5	Key results	18	Summarise key results with reference to study objectives	p13
6	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	p14
7				
8	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	p14-15
9				
10	Generalisability	21	Discuss the generalisability (external validity) of the study results	p14-15
11				
12	<b>Other information</b>			
13	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	p16
14				
15				
16				

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.



# BMJ Open

## Rates of turnover among general practitioners: a retrospective study of all English general practices between 2007-2019

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<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	General practice / Family practice, Health services research, Medical management
Keywords:	PRIMARY CARE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Organisation of health services < HEALTH SERVICES

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# Rates of turnover among general practitioners: a retrospective study of all English general practices between 2007-2019

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## Abstract

### Objective

To quantify general practitioners' (GPs) turnover in England between 2007-2019, describe trends over time, regional differences and associations with social deprivation or other practice characteristics.

### Design

A retrospective study of annual cross-sectional data.

### Setting

All general practices in England (8,085 in 2007, 6,598 in 2019).

### Methods

We calculated turnover rates, defined as the proportion of GPs leaving a practice. Rates and their median, 25<sup>th</sup> and 75<sup>th</sup> percentiles were calculated by year and region. The proportion of practices with persistent high turnover (>10%) over consecutive years were also calculated. A negative binomial regression model assessed the association between turnover and social deprivation or other practice characteristics.

### Results

Turnover rates increased over time. The 75<sup>th</sup> percentile in 2009 was 11%, but increased to 14% in 2019. The highest turnover rate was observed in 2013-2014, corresponding to a 75<sup>th</sup> percentile of 18.2%. Over time, regions experienced increases in turnover rates, although it varied across English regions. A rise in the number of practices with persistent high turnover (>10%) for at least 3 consecutive years was also observed, from 2.7% (2.3% to 3.1%) in 2007 to 6.3% (5.7% to 6.9%) in 2017. The statistical analyses revealed that practice-area deprivation was moderately associated with turnover rate, with practices in the most deprived area having higher turnover rates compared to practices in the least deprived areas (IRR 1.0; 1.06 to 1.13).

### Conclusions

GP turnover has increased in the last decade nationally, with regional variability. Greater attention to GP turnover is needed, in the most deprived areas in particular, where GPs often need to deal

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3 with more complex health needs. There is a large cost associated with GP turnover and practices  
4 with very high persistent turnover need to be further researched, and the causes behind this  
5 identified, to allow support strategies and policies to be developed.  
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For peer review only

### Strengths and limitations of the study

- This study goes a step further than previous research, in quantifying and describing GPs' actual turnover over a 12-year period, rather than "intention to leave".
- It used two national administrative datasets, regularly updated and monitored, which have the advantage of including everyone rather than only respondents to a survey.
- It also presented methodological advances in combining multiple data sources containing information about the primary care workforce and historical data of individual GPs' characteristics.
- However, only a limited set of covariates was available in the national administrative datasets, when many more are relevant to turnover.
- Finally, it was not possible to distinguish between those GPs who moved to a different practice, retired or left primary care completely.

## Introduction

Primary care has a key role in the UK healthcare system, with general practitioners (GPs, family physicians in the US) the first point of contact for patient care. However, recent data have shown that the GP workforce in England is going through a major crisis,<sup>1</sup> reflected in increasing rates of early retirement and intentions to reduce hours of working or leave their practice in the near future.<sup>2</sup> Despite this being a common problem for other European countries<sup>3</sup> and globally,<sup>4</sup> it seems to be particularly serious for the UK.<sup>3 5</sup> According to an international survey of general practitioners from 2015, approximately 30% of GPs want to leave their profession within 5 years.<sup>3</sup>

A 2019 report conducted by the Health Foundation highlighted that while there has been an increase in the number of hospital-based doctors, the number of GPs has reduced<sup>6</sup>; NHS staff retention has worsened since 2011/12 and, despite this being a UK government priority, there has been no improvement in retention in recent years.<sup>6</sup> Prior to the 2015 elections, the UK government promised 5,000 more doctors in primary care by 2020.<sup>7</sup> However, recent data from regional and national surveys indicate the number of full-time equivalent GPs per 1000 patients continues to decline. Regionally, GP surveys from West Midlands<sup>8</sup> and South West England<sup>9</sup> found that 41.9% and 70% of participants intended to leave the practice or were likely or very likely to pursue a career choice that would negatively impact the GP workforce within the next 5 years, respectively. Likewise, the most recent national survey of 2,195 GPs in England conducted in 2017 reported that 39% intended to leave 'direct patient care' within 5 years, compared with 19.4% in 2005.<sup>2</sup>

GP retention measures the percentage of staff staying in a practice for a defined period of time. GP turnover measures the proportion of staff who leave. Both are important indicators of the behaviour of doctors in the primary care workforce.<sup>6</sup> While retention is an indicator of the stability of a practice workforce, GP turnover is highly correlated with the desire to quit the profession, although this may in part be due to GPs retiring or simply moving practice.

Low retention or decreasing retention levels over time and high turnover rates are a major issue for NHS primary care. High GP turnover is a concern for several reasons: it may be associated with practices experiencing recurring problems with recruitment and retention<sup>10</sup>; it may affect the ability to deliver primary care services<sup>4</sup>; and undermine continuity of care which in turn may



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2  
3 affect the quality of patient care. For instance, healthcare received from multiple GPs can lead to  
4 conflicting therapeutic treatments and fragmented care.<sup>11</sup> Conversely, the benefits of continuity  
5 of care has been documented in studies which linked greater continuity of care with higher  
6 patient satisfaction,<sup>12</sup> reduction in costs of care,<sup>13</sup> reduced risk of hospitalisation and lower  
7 mortality.<sup>14</sup> Differential turnover across practices and regions could also lead to a maldistribution  
8 of GPs, exacerbating retention problems<sup>10</sup> and health inequalities. It is also important to highlight  
9 that there is a large cost associated with GP turnover,<sup>15</sup> estimated to be 2 to 3 times the doctor's  
10 annual salary.<sup>16</sup> These costs include direct costs (separation costs, recruitment, induction and  
11 temporary replacement costs),<sup>17</sup> but also indirect or long term costs such as overwork by other  
12 staff plus the 'costs' in terms of quality of care. For instance, lower quality of care may lead to  
13 fewer patients seeking early diagnosis/treatments with long term costs for the NHS as a whole.  
14 Lastly, GP turnover costs are likely to increase in the future due to the GP shortages which are  
15 linked but not necessarily are a consequence of turnover.

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Despite existing concerns about retention and turnover levels in England, studies quantifying  
movements of the GP workforce are scarce with the most recent reporting data from the early  
90s.<sup>10</sup> Recently, Buchan et al (2019) in their report conclude that further research is required  
particularly to investigate actual turnover as opposed to intentions to leave.<sup>6 18</sup>

In England, detailed administrative data about the primary care workforce are collected and  
include practice-related characteristics as well as historical data on when a GP joins and leaves a  
practice. Compared to surveys, administrative data have the advantage that everyone is included  
rather than only the respondents and it is based on actual behaviour rather than intentions.  
However, these data have rarely been used to quantify actual GP turnover rates.

In this study we used national data from NHS Digital, NHS Prescribing and the NHS  
Organisation Data Service to explore GP turnover rates over time and regionally, as well as to  
identify practice-level factors associated with them.

## Methods

The overall aim of the study was to explore turnover rates of GPs and look at trends in turnover  
in different regions over time in England between 2007-2019. In particular, the study aimed to:

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3 quantify rates of GP turnover in England, their trends over time, their differences across regions,  
4 and the predictors of GP turnover.  
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### 9 **Definition of GP turnover rates**

11 With the aim of quantifying trends of GPs leaving general practices, turnover was defined as the  
12 number of GPs who leave a practice divided by the average of the number of GPs at the start and  
13 the number of GPs at the end of the year. This rate definition is similar to that used in previous  
14 studies on GPs turnover<sup>10 17</sup> and the current definition used by the NHS.<sup>19</sup>  
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$$21 \textit{Turnover rate} = \frac{N \textit{ GPs leaving a practice in a year}}{\textit{Average number of GPs in a year}} \times 100$$

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26 Where:

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29 *Average number of GPs in a year = (GPs in a practice at the start of the year + GPs in a practice*  
30 *at the end of the year)/2;*  
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33 and

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35 *GPs in a practice at the end of the year = Number of GPs at start of the year + Number of joiners*  
36 *– Number of leavers*  
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42 Furthermore, with the aim of having a comprehensive picture on the movement of general  
43 practitioners, two additional measures were calculated: joiners' and retention rates, which  
44 describe i) the proportion of GPs who join a practice during the year; and, ii) the proportion of  
45 GPs who stay in a practice for entire year, respectively. Therefore, while retention indicates the  
46 ability of a practice to retain its staff, a high rate of joiners is likely to generate a high rate of  
47 turnover due to the association of low tenure with likelihood to quit. Rates and statistical  
48 analyses of turnover are presented in the main paper, whereas retention and joiners' rates are  
49 described and reported in the Supplementary Material Tables 1 and 2.  
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## Data sources

### GP workforce dataset

General practices are required to provide data about staff working at NHS practices or other primary care organisations in England. NHS Digital, previously the Health and Social Care Information Centre (HSCIC), regularly publishes workforce datasets which include information on individual GPs and practice level characteristics since 1995. These datasets are publicly available on the NHS Digital website<sup>20</sup>. This study used the annual datasets (September releases) between 2007 and 2020 and the files containing practice-level data containing all the information relative to a practice.

### Membership of practices

GPs in England are issued a code when they start prescribing, the GPs Primary General National Code (GNC), which is associated with their main prescribing cost centre and is issued by the NHS Prescription Services (NHS RxS). These codes are published by the NHS Organisation Data Service (ODS) on behalf of the NHS RxS. In particular, information about individual prescribing code of GPs (General National Code, GNC) and the date a GP has joined and left a practice, are included in the General Medical Practitioners data and the General Medical Practices, GPs-by-general practice data (GP membership-epracmem), respectively. In these data, each GP has an entry for every main prescribing cost centre (GP practice) where they have worked. Dates of when a GP joins and leaves a GP practice enables the calculation of GP turnover across a specified time window. These datasets include information only on those GPs who can prescribe i.e. GP partners and salaried GPs. These data are published free of charge and capture information on GP membership to each practice from 1974 and are updated weekly on the NHS Technology Reference data Update Distribution (TRUD)<sup>21</sup> website. Data on GP membership of practices were extracted on the second week of November 2020. Supplementary material Figure 1 summarises the data process.

## Study design and study population

Practice-level GP workforce data were linked to the GPs-by-GPs practice data (*GP membership-epracmem*) using the practice code and each year included practices that were common in both

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3 data sources. The practice-level GP workforce files were used to identify practice characteristics  
4 and the GPs-by-GPs practice data (*GP membership-epracmem*) to calculate turnover rates  
5 combined for GP partners and salaried GPs given that these are the only GPs able to prescribe  
6 and whose information is included in the datasets. Joiners' and retention rates are described and  
7 reported in the Supplementary material Tables 1 and 2, respectively).  
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## 14 **Statistical analyses**

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16 Only practices with at least 750 registered patients were included in the analyses. Smaller  
17 practices were omitted (714, 8.1%, practices during the entire study window) as they could have  
18 been reducing patient numbers in preparation for closure which itself would affect GP turnover;  
19 or they could be newly formed practices which might have exhibited different recruiting  
20 behaviours. Finally, practices with no GPs left at the end of the year in question (because they  
21 were closing in the following years) were excluded from the analyses (2006, 22.8% practices  
22 during the entire time window). A table with the distribution of these practices and their turnover  
23 rates are provided in Supplementary Material Table 3.  
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### 30 *GP turnover rate over time and by NHS regions*

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32 Using the GPs-by-GPs practice data (*GP membership-epracmem*), turnover rates were calculated  
33 for each practice and for every year in the study window (2007-2019). To summarise GP  
34 movement, the following analyses were performed. Firstly, summary statistics including mean  
35 (standard deviation, SD), 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> percentiles were calculated and violin plots produced.  
36 Violin plots are similar to box plots (including the median as a marker and a box indicating the  
37 interquartile range), but overlaid with the distribution of the data for better visualisation.  
38 Secondly, the proportion of practices with low, medium, high and very high turnover rate (equal  
39 to 0%, between 0% and <10%, between 10% and <40%, and  $\geq 40\%$ , respectively) were computed  
40 for every year. Although arbitrary, these thresholds were chosen to understand better the extent  
41 of turnover and whether there was a high proportion of practices with extreme values. Thirdly,  
42 the proportion of practices with persistent high turnover (>10%) across two, three, four, and five-  
43 years window was calculated with the intent to explore whether practice turnover might have  
44 indicated a temporary situation (2 or 3 years persistent high turnover) or a continuing problem (4  
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3 or 5 years persistent high turnover). Finally, turnover rates were produced at regional level using  
4 the most recent classification of NHS region and rates compared between 2007 versus 2019.  
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### 6 7 *Predictors of GP turnover rates* 8

9 To identify factors influencing turnover, count data models were fitted to estimate incidence rate  
10 ratios (IRR) and 95% confidence intervals (CIs) of turnover rates. Specifically, a negative  
11 binomial distribution model was employed, this is the most appropriate model in the presence of  
12 overdispersion of the data. To explore the hypothesis that social deprivation of people living in  
13 the area where a practice was located is likely to increase turnover, the variables included in the  
14 primary model were average levels of deprivation where the practice was located (Index of  
15 Multiple Deprivation, IMD, 2015) categorised in quintiles and year in the study window. There  
16 was a small proportion of missing data for IMD (0.08%) in the main analysis and type of  
17 contract (0.30%) in the sensitivity analyses. For these variables, an extra category was included  
18 to indicate a missing value.  
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27 Multiple sensitivity analyses were performed to test the robustness of the results. i) Restricting  
28 the analysis to practices active for the entire time-window to check whether opening or closing  
29 practices affected turnover rates. ii) Excluding from the analysis practices that had an Alternative  
30 Provider Medical Service (APMS) contract rather than those having a General Medical Service  
31 (GMS) or Personal Medical Service (PMS) contract. This allowed us to explore whether turnover  
32 rates were affected by the type of contract of a practice. iii) Fitting a random effect model with  
33 NHS region as random effect to understand whether regional variability influenced turnover  
34 rates. iv) Restricting the analysis to 2015-2019 given that more information was available for this  
35 time-window and it was possible to include additional variables in the model other than practice-  
36 area social deprivation (IMD 2015) and year. These variables were full-time-equivalent (FTE)  
37 per 1000 patients ratio and proportion of salaried GPs in the practice, which were included to  
38 explore whether GPs workload and practice network structure (with salaried GPs more likely to  
39 leave) were associated with levels of turnover.  
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## Patients and Public Involvement

Patients and public involvement (PPI) members were involved in the project. They did not contribute to the research question or study design, but provided feedback on the study findings. In particular, a forum group was organised with five PPI members. They agreed that GPs leaving a practice had a negative influence on patients' quality and continuity of care. They highlighted the following points regarding the potential disruption of their relationship with their GP: lack of communication and feeling apprehensive when they had to meet a new or different GP. Overall a personal relationship with the GP was very important, although often practices did not meet patients' expectations.

## Results

### GP turnover rates and their trends over time and by NHS region

After merging the GP workforce data with the GPs-by-GPs practice data (*GP membership-epracmem*), the number of practices included in the analyses decreased during the study window, from 8,085 practices in 2007 to 6,598 in 2019 (Table 1). Supplementary material Figure 1 summarises the data process.

Overall, half of the practices had zero turnover rate within each year of analysis. Over time, turnover rates increased during the study window; in particular, in 2009, the 75<sup>th</sup> percentile corresponded to an 11% rate and this had increased to 14% in 2019. However, the increase was not linear as the peak occurred in 2013-2014 when the 75<sup>th</sup> percentile of turnover corresponded to 18%. Summary statistics for turnover rates over time are reported in Table 1 and by violin plots in Supplementary Figure 2).

Between 2007 and 2019 the proportion of practices with low turnover (equal to 0%, meaning that no GP left the practice that year) decreased from 79% (in 2007) to 61% (in 2019), whereas the proportion of practices with medium turnover rates (below 10%) slightly increased from 1% in 2007 to 5% in 2009. Overall, 14% of the practices had high turnover (corresponding to 10%-40%) in 2007 a share that increased to 27% in 2019. Approximately 8% of the practices showed very high turnover (above 40%) during the entire time window (Table 2 and Figure 1).

Turnover rates showed great variation across regions. When regional turnover rates were compared at the beginning and end of the study window, all the NHS regions had an increase in

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3 turnover rates (2007 vs 2019) (Figure 2). NHS England Midlands and East (West Midlands) had  
4 the largest increase in turnover rate (on average 6%), varying from 6% in 2007 to 12% in 2019;  
5 whereas NHS England Lancashire and South Cumbria had nearly no increase in turnover (on  
6 average 0%) (Figure 2). For all the regions, trends of turnover were not always consistently  
7 increasing but demonstrated peaks around 2013-2014.  
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12 Finally, when examining persistent high turnover over time (>10%), findings revealed that,  
13 between 2007 and 2013, there had been a steady increase in the proportion of practices with  
14 persistent high turnover either for 2-3 consecutive years (temporary situation) or for 4-5  
15 consecutive years (continuing problem). Practices with high turnover over two years, for  
16 example, increased from 6.0% in 2007 to 17.6% in 2013, before decreasing to 14.4% in 2018  
17 (Figure 3 and Supplementary Table 4).  
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### 23 Predictors of GPs turnover

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25 The statistical analyses investigating predictors of GPs turnover revealed that area-deprivation of  
26 a practice and year were associated with turnover rate. In particular, practices in the most  
27 deprived locations had a greater risk of higher turnover compared to practices in the least  
28 deprived areas (IRR 1.09; 1.06 to 1.13); and every year in the study window was associated with  
29 an increasing turnover rate compared to 2007 (Table 3), with 2013 and 2014 associated with the  
30 highest turnover rates compared to 2007 (IRR 1.67; 1.59 to 1.77 and IRR 1.74; 1.64 to 1.83)  
31 (Table 3) and Figure 4.  
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### 41 Sensitivity analyses

42 Results from sensitivity analyses confirmed the main findings. This was the case when the  
43 analysis was restricted to practices active for the entire time window; or when practices with  
44 APMS contract were excluded; or when a random effect model for NHS region was fitted (Table  
45 4). When the time-window included only practices between 2015 and 2019 and additional  
46 variables were included in the statistical model, area-practice deprivation (IRR 1.08; 1.02 to  
47 1.13, practices located in most deprived areas vs least deprived areas), proportion of salaried GPs  
48 (IRR 1.69; 1.59 to 1.79), and year 2018 compared to 2015 (IRR 1.12; 1.07 to 1.18) were all  
49 significantly associated with higher turnover; whereas lower workload, as expressed by the FTE  
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per 1,000 patients ratio, was associated with lower turnover rate (IRR 0.84; 0.78 to 0.90) (Table 5).

## Discussion

### Main findings

For the first time, rather than intention to leave, this study describes levels of GPs turnover over a 12-year window (2007-2019) and its variation by geographical regions in English primary care. In addition, it also reports on practice-area social deprivation and practice staffing relative to patient lists that were associated with higher or lower levels of GPs turnover, respectively.

In the backdrop of a trend towards fewer and larger general practices,<sup>22</sup> our findings revealed that turnover rates increased over the study period, although overall changes were small.

Interestingly, turnover rates were the highest during 2013-2014. Over time, the proportion of practices with high turnover increased by 13% and those with very high turnover remained at the same level (around 8%). The majority of NHS regions experienced a rise in turnover between 2007 and 2019, which was greater in some regions than others. For instance, NHS England West Midlands was the region worst affected. Results also showed that, over time, there was a rising number of practices with persistent high turnover for at least five consecutive years, indicative of a continuing problem for these practices. However, this was not associated with practice-level deprivation (results not shown). Finally, there was a significant association between practice area social deprivation and levels of turnover rates. Specifically, practices located in most deprived areas were associated with the likelihood of higher GP turnover compared to practices located in least deprived areas.

### Strengths and limitations of the study

The study has several strengths. First, it quantified and described GPs' actual turnover rather than "intentions to leave" usually reported in existing studies.<sup>2,23</sup> Second, it used two national administrative datasets, regularly updated and monitored by NHS Digital and the NHS Prescription Service (RXS)/NHS Organisation Data Service, which have the advantage of including everyone rather than only respondents to a survey, therefore they might be less prone to bias. Third, the study provided rates for a 12-year window and across regions of England.



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3 Fourth, the approach employed to calculate turnover rates, used the exact dates when a GP joined  
4 and left a practice, therefore more accurate than using aggregate data.<sup>10</sup> Fifth, it presented  
5 methodological advances in combining multiple data sources containing information about the  
6 primary care workforce and historical data of individual GPs' characteristics.  
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10 Limitations of the study need to be acknowledged as well. Despite the fact the workforce data  
11 provide a wealth of information on practices characteristics, the main analyses performed in the  
12 study included only basic variables (such as practice area social deprivation and year). This was  
13 due to NHS Digital employing a revised methodology to calculate some variables (such as GPs'  
14 FTE) from 2015, therefore these data are not comparable with previous years. In addition, it was  
15 not possible to have detailed information on individual GP demographics (age and gender) and  
16 their employment model from the GP workforce datasets, therefore all the rates presented are  
17 combined for GP partners and salaried GPs. Confidence intervals for the proportions are not  
18 reported since the sample is large and there is very little uncertainty around the estimates. Hence,  
19 these would add complexity but little to no new information. Finally, it was not possible to  
20 distinguish between those GPs who moved to a different practice, retired or left primary care  
21 completely. Nevertheless, joiners' and retention rates have also been provided (in the  
22 Supplementary material) to give a comprehensive description of the GPs workforce behaviour of  
23 joining, staying or leaving a practice.  
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### 35 **Comparison with other studies**

36 Studies examining GP turnover rates in England are scarce and relate to the early 90s.<sup>10 24</sup>  
37 Compared to Taylor *et al.*,<sup>10</sup> turnover rates are slightly higher in our study, but this can be  
38 attributed to the different time-window analysed or to differences in the methodology used, such  
39 as combining multiple data sources, using the exact date a GP has joined or left a practice, and  
40 including all types of working patterns rather than those GPs practicing full time only.<sup>10</sup> Similar  
41 to their findings is the variation of turnover by region and its association with social  
42 deprivation.<sup>10</sup> Increasing turnover and regional variation have also been found across NHS  
43 Trusts in England for other healthcare professionals.<sup>25</sup> Our findings also need to be evaluated in  
44 the context of rates of intentions to leave direct patient care within 5 years, as reported in  
45 national GP surveys.<sup>2</sup> We cannot directly compare the rates we report and those from the  
46 surveys, since we cannot quantify those who leave direct patient care, only practice turnover, and  
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3 we measure that annually, not over 5 years. However, there was discrepancy in trends, with  
4 “intention to leave” rates increasing from 19.4% in 2005 to 39% in 2017, and we would have  
5 expected a much larger increase in turnover if the intentions reported were fully followed  
6 through. Alternatively, perhaps there is an imminent large increase in turnover expected by 2022.  
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### 10 **Interpretation of findings and implication for practice**

11 Findings from our study have revealed that there was an increase in GP turnover over the last  
12 decade. This trend may be partially explained by the rising number of GPs intending to leave  
13 their profession or having a career break,<sup>2 23</sup>, although there was a discrepancy in rates as  
14 previously described. Burnout is considered a key factor contributing to this intention,<sup>26</sup> known  
15 to be driven by increasing workload through patients with complex needs,<sup>27</sup> although the link to  
16 turnover is tenuous.<sup>28</sup> Other factors relevant to turnover include: lack of or reduced job  
17 satisfaction,<sup>8 23</sup> dissatisfaction with the “amount of responsibility given”,<sup>2</sup> “physical working  
18 conditions”,<sup>2</sup> and time spent on “unimportant tasks”.<sup>8</sup> The reasons behind the peak of turnover in  
19 2013-2014 are unclear; this coincides with the introduction of the APMS contract, but we could  
20 confirm causality.  
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30 Existing literature highlights that GPs often find managing patients in areas of socioeconomic  
31 deprivation a challenge due to the higher prevalence of multimorbidity and the associated  
32 healthcare needs.<sup>29-31</sup> The higher turnover rates observed in more deprived areas might also be  
33 related to differences in the distribution of GP or other healthcare professional workforce, though  
34 it is difficult to determine whether these differences are the cause or consequence of higher GP  
35 turnover.  
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41 Regional variations in turnover might be due to different levels of social deprivation across the  
42 regions and varying health services’ pressures. Whereas, the persistent high turnover experience  
43 by a number of practices, indicative of a continuing and unresolved problem within the practice  
44 or area rather than temporary situation, might be associated with practices experiencing problems  
45 with recruitment and retention for specific reasons.<sup>10</sup> There is also variation in the characteristics  
46 of the GPs across regions, with some regions being served by older or overseas qualified GPs,  
47 who may be more mobile.<sup>32</sup>  
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54 High or increasing GP turnover is a concern for the entire healthcare system, especially  
55 considering existing difficulties in replacing retiring GPs.<sup>32</sup> Recently, the ReGROUP project  
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3 concluded that policies and strategies to address the existing healthcare workforce crisis in  
4 primary care and maximise retention of GPs should facilitate sustainable GP workload and  
5 contractual requirements, as well as the need for personal and professional support; in addition to  
6 target areas which influence job satisfaction and work-life balance.<sup>33</sup>  
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## 10 **Conclusions**

11 We observed a small overall increase in GP turnover in the last decade across the whole of  
12 England, supporting previous local investigations and national surveys – although that increase  
13 was no linear, with a turnover peak in 2013-14, coinciding with the introduction of the APMS  
14 contract. Greater attention to GP turnover is needed, particularly in the most severely deprived  
15 areas, to address the complex health needs of the population living in these areas and avoid the  
16 exacerbation of health inequalities. Moreover, there is a large cost associated with GP turnover  
17 and practices with very high persistent turnover need to be further investigated. Finally, targeted  
18 policies and strategies need to be developed and tested to diminish its occurrence.  
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## Contributors

PB, KC, JR, MS, AE, SS, YSL, SG and EK secured funding for the study. RP, YSL and EK designed the analyses. RP performed the statistical analyses with input from PB, KC, JR, MS, AE, SS, YSL, SG and EK. RP drafted the paper and PB, KC, JR, MS, AE, SS, YSL, SG and EK critically revised it. RP is the guarantor. The corresponding author attests that all listed authors meet authorship criteria and no others meeting the criteria have been omitted.

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All decisions concerning analysis, interpretation, and publication are made independently from the funder.

## Competing interests

All authors declare no competing interests.

## Ethical Approval

Not required. Analyses relate to publicly available data on health professionals, not patients.

## Data sharing

The GP workforce and the GPs-by-general practices data are freely available from the NHS Digital and TRUD websites, respectively.

## Author's statement

The lead author affirms that the manuscript is an honest, transparent account, of the study being reported; and that no important aspects have been omitted; and that any discrepancy from the study as planned have been explained.

## References

1. RCGP. New league table reveals GP shortages across England, as patients set to wait week or more to see family doctor on 67 m occasions (Accessed 22.7.2020). 2015.
2. Gibson J, Sutton M, Spooner S, Checkland K. Ninth National GP Worklife Survey. 2018.
3. Martin S, Davies E, Gershlick B. Under pressure: What the Commonwealth Fund's 2015 international survey of general practitioners means for the UK. 2016.
4. Shen X, Jiang H, Xu H, Ye J, Lv C, Lu Z, et al. The global prevalence of turnover intention among general practitioners: a systematic review and meta-analysis. *BMC Family Practice* 2020;21:246.
5. Hayes H, Gibson J, Fitzpatrick B, Checkland K, Guthrie B, Sutton M, et al. Working lives of GPs in Scotland and England: cross-sectional analysis of national surveys. *BMJ Open* 2020;10:e042236.
6. Buchan J, Charlesworth A, Gershlick B, Seccombe I. A critical moment: NHS staffing trends, retention and attrition. 2019.
7. Hunt J. New deal for general practice. Jeremy Hunt sets out the first steps in a new deal for GPs. 2015.
8. Dale J, Potter R, Owen K, Parsons N, Realpe A, Leach J. Retaining the general practitioner workforce in England: what matters to GPs? A cross-sectional study. *BMC Family Practice* 2015;16:140.
9. Fletcher E, Abel GA, Anderson R, Richards SH, Salisbury C, Dean SG, et al. Quitting patient care and career break intentions among general practitioners in South West England: findings of a census survey of general practitioners. *BMJ Open* 2017;7:e015853.
10. Taylor DH, Jr., Leese B. General practitioner turnover and migration in England 1990-94. *Br J Gen Pract* 1998;48:1070-72.
11. Reddy A, Pollack CE, Asch DA, Canamucio A, Werner RM. The Effect of Primary Care Provider Turnover on Patient Experience of Care and Ambulatory Quality of Care. *JAMA Internal Medicine* 2015;175:1157-62.
12. Fan VS, Burman M, McDonnell MB, Fihn SD. Continuity of care and other determinants of patient satisfaction with primary care. *Journal of general internal medicine* 2005;20:226-33.
13. Hussey PS, Schneider EC, Rudin RS, Fox DS, Lai J, Pollack CE. Continuity and the Costs of Care for Chronic Disease. *JAMA Internal Medicine* 2014;174:742-48.
14. Nyweide DJ, Anthony DL, Bynum JPW, Strawderman RL, Weeks WB, Casalino LP, et al. Continuity of Care and the Risk of Preventable Hospitalization in Older Adults. *JAMA Internal Medicine* 2013;173:1879-85.
15. Buchbinder S, Wilson M, Melick C, Powe N. Primary care physician job satisfaction and turnover. *Am J Manag Care* 2001;7:701-13.
16. Shanafelt T, Goh J, Sinsky C. The Business Case for Investing in Physician Well-being. *JAMA Internal Medicine* 2017;177:1826-32.
17. Buchan J. Reviewing The Benefits of Health Workforce Stability. *Human Resources for Health* 2010;8:29.

18. Hann M, Reeves D, Sibbald B. Relationships between job satisfaction, intentions to leave family practice and actually leaving among family physicians in England. *European Journal of Public Health* 2010;21:499-503.
19. NHS Digital. Joiners and leaver rates with stability index 2016 -2018. <https://digital.nhs.uk/data-and-information/find-data-and-publications/supplementary-information/2019-supplementary-information-files/leavers-and-joiners/joiners-and-leaver-rates-with-stability-index-2016---2018>.
20. NHS Digital. General Practice Workforce. <https://digital.nhs.uk/data-and-information/publications/statistical/general-and-personal-medical-services>. <https://digital.nhs.uk/data-and-information/publications/statistical/general-and-personal-medical-services>
21. NHS Digital TRUD. NHS ODS weekly prescribing-related data. <https://isd.digital.nhs.uk/trud3/user/guest/group/0/pack/5>
22. PULSE. Average practice list size grows by more than 2% in just eight months. <https://www.pulsetoday.co.uk/news/practice-closures/average-practice-list-size-grows-by-more-than-2-in-just-eight-months/>
23. Gibson J, Checkland K, Coleman A, Hann M, McCall R, Spooner S, et al. Eighth National GP Worklife Survey. 2015.
24. Taylor DH, Jr., Brenda L. Recruitment, retention, and time commitment change of general practitioners in England and wales, 1990-4: a retrospective study. *BMJ* 1997;314.
25. Buchan J, Charlesworth A, Gershlick B, Seccombe I. Rising pressure: the NHS workforce challenge. 2017.
26. Cheshire A, Ridge D, Hughes J, Peters D, Panagioti M, Simon C, et al. Influences on GP coping and resilience: a qualitative study in primary care. *British Journal of General Practice* 2017;67:e428-e36.
27. Pedersen AF, Noroxe KB, Vedsted P. Influence of patient multimorbidity on GP burnout: a survey and register-based study in Danish general practice. *Br J Gen Pract* 2020;70:e95-e101.
28. Pedersen AF, Andersen CM, Olesen F, Vedsted P. Risk of Burnout in Danish GPs and Exploration of Factors Associated with Development of Burnout: A Two-Wave Panel Study. *Int J Family Med* 2013;2013:603713.
29. Eley E, Jackson B, Burton C, Walton E. Professional resilience in GPs working in areas of socioeconomic deprivation: a qualitative study in primary care. *British Journal of General Practice* 2018;68:e819.
30. O'Brien R, Wyke S, Guthrie B, Watt G, Mercer S. An 'endless struggle': a qualitative study of general practitioners' and practice nurses' experiences of managing multimorbidity in socio-economically deprived areas of Scotland. *Chronic Illn* 2011;7:45-59.
31. Long L, Moore D, Robinson S, Sansom A, Aylward A, Fletcher E, et al. Understanding why primary care doctors leave direct patient care: a systematic review of qualitative research. *BMJ Open* 2020;10:e029846.
32. Esmail A, Panagioti M, Kontopantelis E. The potential impact of Brexit and immigration policies on the GP workforce in England: a cross-sectional observational study of GP qualification region and the characteristics of the areas and population they served in September 2016. *BMC Medicine* 2017;15:191.

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3 33. Chilvers R, Richards SH, Fletcher E, Aylward A, Dean S, Salisbury C, et al. Identifying policies  
4 and strategies for general practitioner retention in direct patient care in the United  
5 Kingdom: a RAND/UCLA appropriateness method panel study. *BMC Family Practice*  
6 2019;20:130.  
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For peer review only

**Table 1. GP turnover rates between 2007 and 2019.**

year	N practices	Mean	SD	Median	IQR	25th percentile	75th percentile
2007	8085	6.9	18.0	0.0	0.0	0.0	0.0
2008	8053	7.5	18.2	0.0	0.0	0.0	0.0
2009	8077	9.2	20.3	0.0	11.1	0.0	11.1
2010	8058	9.4	20.0	0.0	11.8	0.0	11.8
2011	8009	10.5	20.8	0.0	15.4	0.0	15.4
2012	7924	10.8	20.2	0.0	16.7	0.0	16.7
2013	7809	11.6	19.3	0.0	18.2	0.0	18.2
2014	7629	12.0	19.9	0.0	18.2	0.0	18.2
2015	7404	9.4	17.4	0.0	14.5	0.0	14.5
2016	7211	9.4	18.0	0.0	14.3	0.0	14.3
2017	6963	9.6	17.2	0.0	15.4	0.0	15.4
2018	6757	10.3	17.0	0.0	16.7	0.0	16.7
2019	6598	9.1	16.0	0.0	14.3	0.0	14.3



**Table 2 Proportion of practices with low, medium, high and very high turnover rates over time.**

Year	N practices	N practices with low turnover	% of practices with low turnover	N practices with medium turnover	% of practices with medium turnover	N practices with high turnover	% of practices with high turnover	N practices with very high turnover	% of practices with very high turnover
2007	8075	6419	79.5	71	0.9	1104	13.7	481	5.96
2008	8053	6208	77.1	95	1.2	1201	14.9	549	6.82
2009	8077	5850	72.4	117	1.4	1448	17.9	662	8.20
2010	8056	5817	72.2	107	1.3	1453	18.0	679	8.43
2011	8008	5538	69.2	90	1.1	1588	19.8	792	9.89
2012	7924	5218	65.9	127	1.6	1858	23.4	721	9.10
2013	7808	4713	60.4	192	2.5	2171	27.8	732	9.38
2014	7629	4482	58.7	199	2.6	2200	28.8	748	9.80
2015	7404	4809	65.0	217	2.9	1863	25.2	515	6.96
2016	7211	4647	64.4	256	3.6	1811	25.1	497	6.89
2017	6963	4359	62.6	257	3.7	1884	27.1	463	6.65
2018	6757	3975	58.8	310	4.6	2016	29.8	456	6.75
2019	6597	4049	61.4	355	5.4	1808	27.4	385	5.84

**Table 3 Predictors of GP turnover rates (primary analysis)**

	IRR (95% CIs)	p-value
<b>IMD</b>		
<b>1 (least deprived)</b>	Reference	
<b>2</b>	1.01 (0.98-1.05)	0.368
<b>3</b>	1.08 (1.04-1.11)	0.000
<b>4</b>	1.09 (1.06-1.13)	0.000
<b>5 (most deprived)</b>	1.12 (1.08-1.16)	0.000
<b>2007</b>	Reference	
<b>2008</b>	1.08 (1.02-1.15)	0.011
<b>2009</b>	1.33 (1.26-1.41)	0.000
<b>2010</b>	1.37 (1.29-1.45)	0.000
<b>2011</b>	1.54 (1.46-1.63)	0.000
<b>2012</b>	1.56 (1.48-1.65)	0.000
<b>2013</b>	1.67 (1.59-1.77)	0.000
<b>2014</b>	1.74 (1.64-1.83)	0.000
<b>2015</b>	1.33 (1.26-1.41)	0.000
<b>2016</b>	1.34 (1.26-1.41)	0.000
<b>2017</b>	1.39 (1.31-1.47)	0.000
<b>2018</b>	1.49 (1.41-1.58)	0.000
<b>2019</b>	1.31 (1.24-1.39)	0.000

**Table 4 Sensitivity analyses. Predictors of GP turnover rates: i) restricting the analysis to practices active for the entire time-window; ii) excluding practices with APMS contract; iii) random-effect model with NHS region as random effect.**

	Practice active for the entire time-window		Excluding practices with APMS contract		Random-effect model with NHS region as random effect	
	IRR (95% CIs)	p-value	IRR (95% CIs)	p-value	IRR (95% CIs)	p-value
<b>IMD</b>						
<b>1 (least deprived)</b>	Reference					
<b>2</b>	1.01 (0.98-1.05)	0.386	1.02 (0.99-1.05)	0.254	1.02 (0.95-1.09)	0.583
<b>3</b>	1.07 (1.04-1.11)	0.000	1.07 (1.04-1.11)	0.000	1.07 (1.01-1.15)	0.031
<b>4</b>	1.08 (1.05-1.12)	0.000	1.09 (1.06-1.13)	0.000	1.09 (1.02-1.17)	0.007
<b>5 (most deprived)</b>	1.09 (1.06-1.13)	0.000	1.11 (1.08-1.15)	0.000	1.10 (1.03-1.18)	0.004
<b>2007</b>	Reference					
<b>2008</b>	1.06 (0.99-1.12)	0.080	1.08 (1.01-1.14)	0.015	1.09 (0.97-1.22)	0.140
<b>2009</b>	1.31 (1.23-1.39)	0.000	1.33 (1.26-1.41)	0.000	1.34 (1.20-1.50)	0.000
<b>2010</b>	1.35 (1.27-1.43)	0.000	1.35 (1.28-1.43)	0.000	1.36 (1.22-1.52)	0.000
<b>2011</b>	1.53 (1.44-1.62)	0.000	1.52 (1.44-1.61)	0.000	1.53 (1.37-1.70)	0.000
<b>2012</b>	1.56 (1.47-1.65)	0.000	1.55 (1.46-1.64)	0.000	1.57 (1.41-1.74)	0.000
<b>2013</b>	1.65 (1.56-1.75)	0.000	1.65 (1.57-1.75)	0.000	1.68 (1.51-1.86)	0.000
<b>2014</b>	1.70 (1.61-1.80)	0.000	1.73 (1.63-1.82)	0.000	1.74 (1.56-1.93)	0.000
<b>2015</b>	1.31 (1.23-1.39)	0.000	1.31 (1.24-1.39)	0.000	1.37 (1.22-1.53)	0.000
<b>2016</b>	1.31 (1.24-1.39)	0.000	1.31 (1.24-1.39)	0.000	1.37 (1.22-1.53)	0.000
<b>2017</b>	1.40 (1.32-1.48)	0.000	1.39 (1.31-1.47)	0.000	1.40 (1.25-1.57)	0.000
<b>2018</b>	1.53 (1.44-1.61)	0.000	1.49 (1.41-1.57)	0.000	1.49 (1.34-1.67)	0.000
<b>2019</b>	1.33 (1.26-1.41)	0.000	1.31 (1.23-1.38)	0.000	1.33 (1.18-1.49)	0.000

**Table 5 Sensitivity analyses. Predictors of GPs turnover restricting the time-window to 2015-2019 and adding “proportion of salaried GPs” and “FTE per 1000 patients ratio” to the model**

	IRR (95% CIs)	p-value
<b>IMD</b>		
<b>1 (least deprived)</b>	Reference	
<b>2</b>	1.05 (1.00-1.10)	0.063
<b>3</b>	1.06 (1.01-1.12)	0.012
<b>4</b>	1.06 (1.01-1.12)	0.013
<b>5 (most deprived)</b>	1.08 (1.02-1.13)	0.004
<b>Proportion of salaried GPs</b>	1.69 (1.59-1.79)	0.000
<b>FTE per 1000 patients ratio</b>	0.84 (0.78-0.90)	0.000
<b>2015</b>	Reference	
<b>2016</b>	0.99 (0.95-1.05)	0.845
<b>2017</b>	1.03 (0.98-1.09)	0.215
<b>2018</b>	1.12 (1.07-1.18)	0.000
<b>2019</b>	0.98 (0.93-1.03)	0.504

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3 **Figure 1 Proportion of practices with low, medium, high and very high turnover over time.**  
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5 Note: The proportion of practices on y-axis has not been multiplied by 100.  
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9 **Figure 2 Comparison of GPs turnover rate according to NHS region 2007 vs 2019.**  
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13 Note: The proportion of practices on y-axis has not been multiplied by 100.  
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17 **Figure 3 Proportion of practices with persistent high turnover rates ( $\geq 10\%$ ) over 2, 3, 4**  
18 **and 5-year window)**  
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20 Note: The proportion of practices on y-axis has not been multiplied by 100.  
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24 **Figure 4 Predicted probabilities of GP turnover according to quantiles of social deprivation**  
25 **(IMD, 2015) and year**  
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27 Note: The proportion of practices on y-axis has not been multiplied by 100.  
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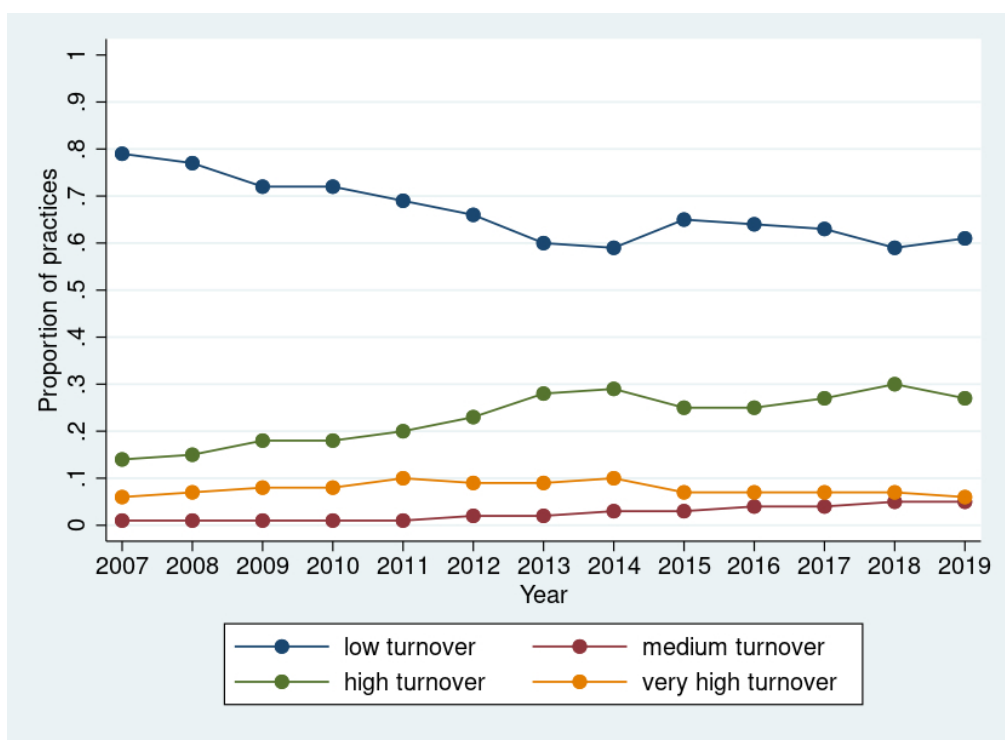


Figure 1 Proportion of practices with low, medium, high and very high turnover over time.

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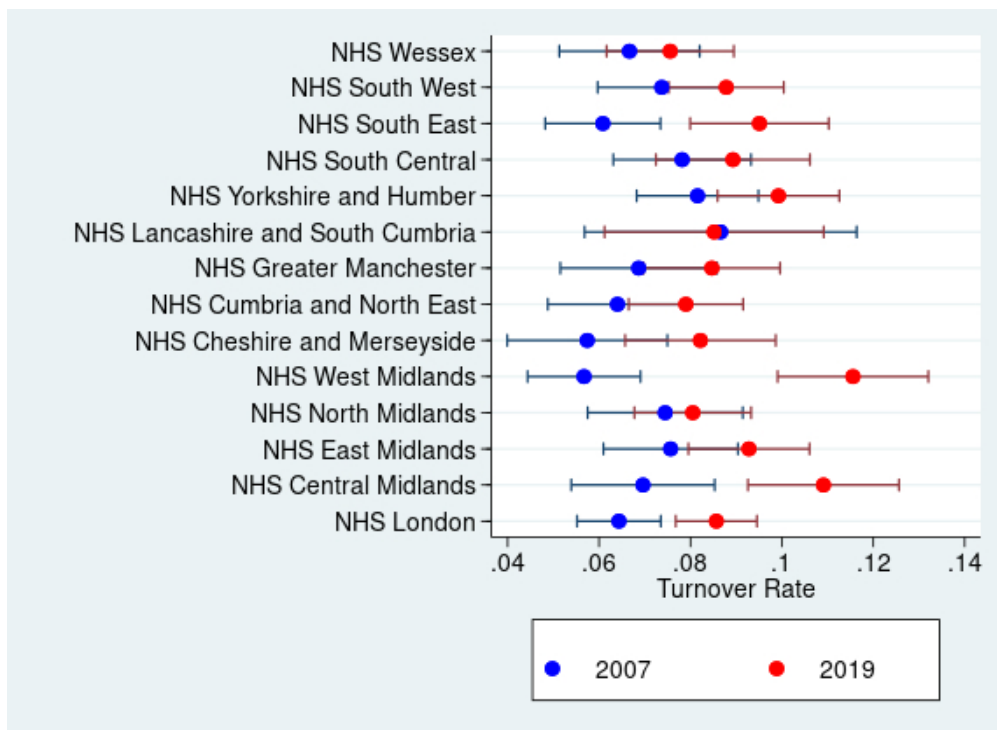


Figure 2 Comparison of GPs turnover rate according to NHS region 2007 vs 2019.

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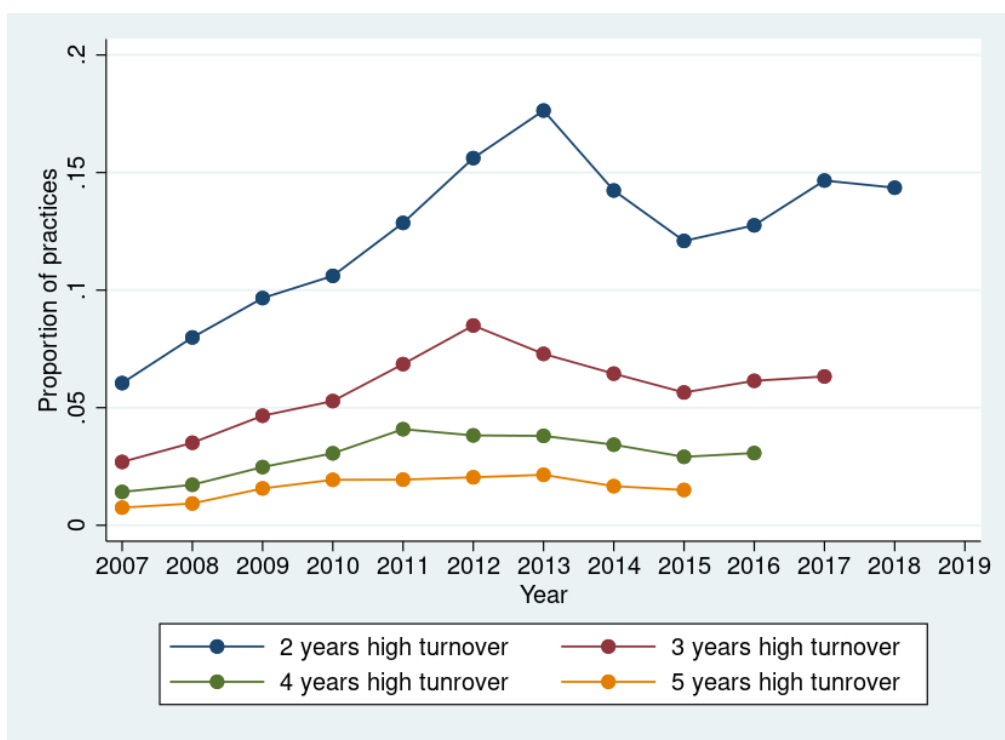


Figure 3 Proportion of practices with persistent high turnover rates ( $\geq 10\%$ ) over 2, 3, 4 and 5-year window)

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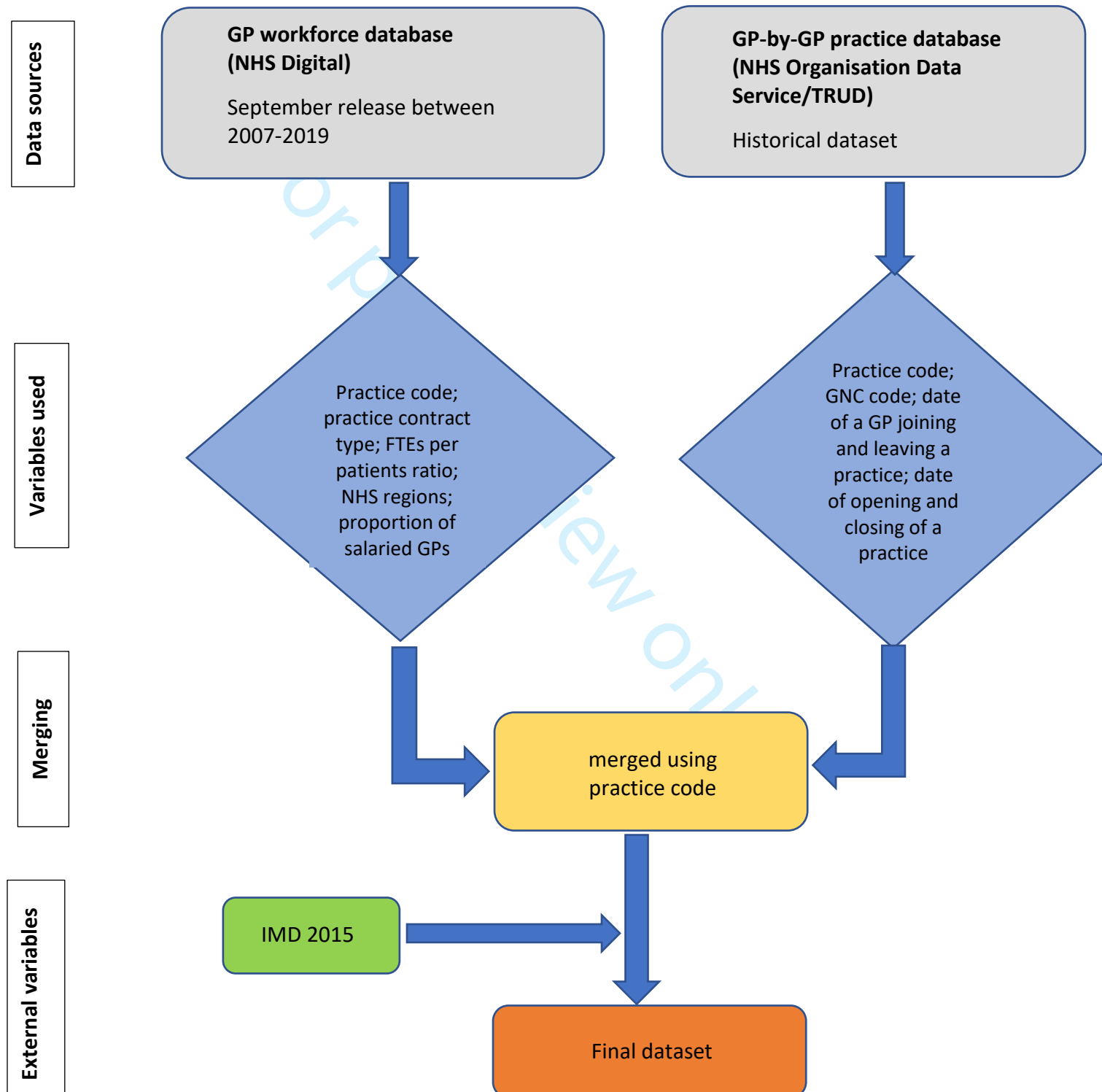


Figure 4 Predicted probabilities of GP turnover according to quantiles of social deprivation (IMD, 2015) and year

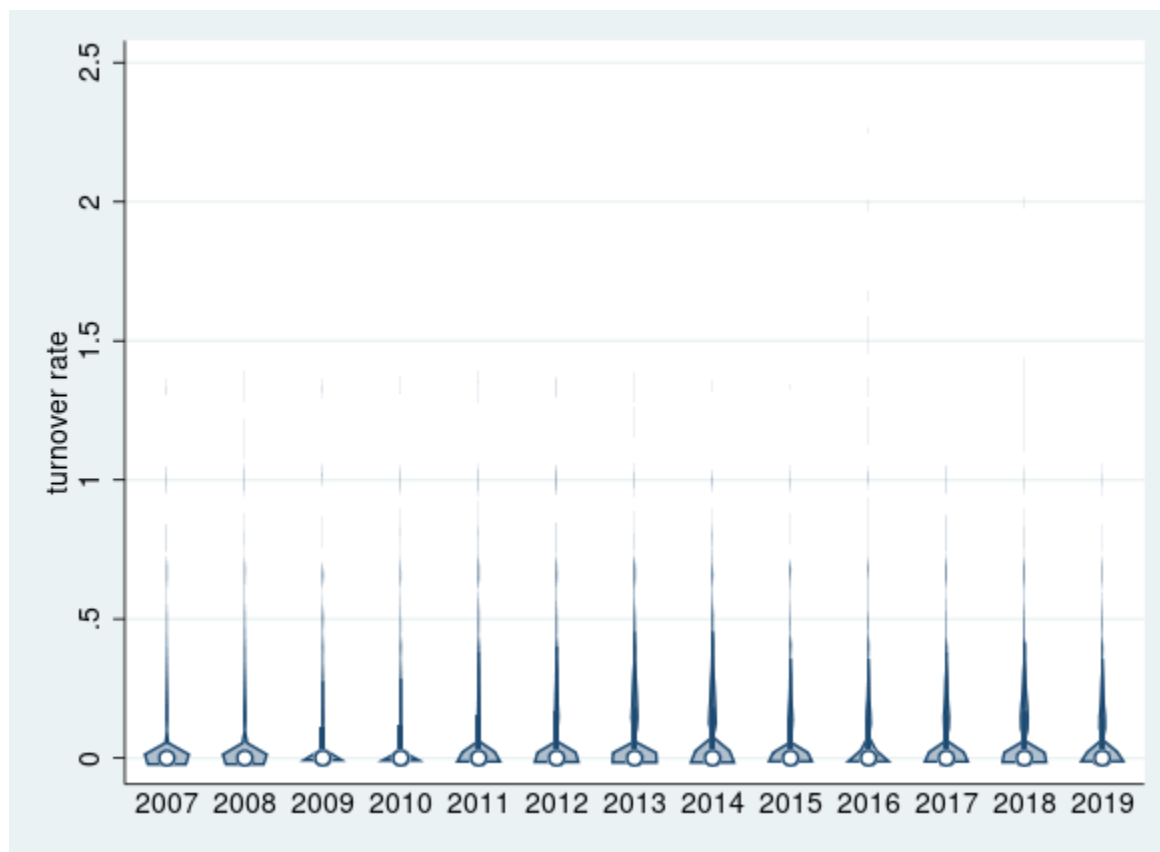
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Supplementary material for “Rates of turnover among general practitioners in England between 2007-2019: a retrospective study”.

Supplementary Figure 1: Flow chart showing the data process



Supplementary Figure 2: Violin plot for general practitioner (GP) turnover rates between 2007 and 2019



Note: Turnover rate on the y-axis have not been multiplied by 100.

## GP Joiners' and retention rates

### Definition of GP joiners' and retention rates

Two additional measures were calculated in order to quantify trends of general practitioners (GPs) and their attitude in leaving general practices, joiners' and retention rates, which describe the proportion of GPs who join a practice during the year and the proportion of GPs who stay in a practice for entire year, respectively.

The following definitions of GPs joiners' rates were used:

$$\text{Joiners' rate} = \frac{\text{GPs in a practice who join during the year}}{\text{*Average number of GPs during the year}} \times 100$$

Where:

Average number of GPs in a year= *(GPs in a practice at the start of the year + GPs in a practice at the end of the year)/2*; and

GPs in a practice at the end of the year= *Number of GPs at start of the year + Number of joiners – Number of leavers*

The following definitions of GPs retention rates was used. Retention did not account for GPs who may join during the year.

$$\text{Retention rate} = \frac{\text{GPs in a practice who stay the entire year}}{\text{GPs at the start of the year}} \times 100$$

**Supplementary Table 1. GP joiners' rate between 2007 and 2019.**

year	N practices	Mean	SD	Median	IQR	25th percentile	75th percentile
2007	8085	9.4	20.3	0.0	12.5	0.0	12.5
2008	8053	9.4	20.0	0.0	11.8	0.0	11.8
2009	8077	10.7	21.6	0.0	15.4	0.0	15.4
2010	8058	11.1	21.2	0.0	16.7	0.0	16.7
2011	8009	11.8	21.4	0.0	18.2	0.0	18.2
2012	7924	13.2	21.9	0.0	20.0	0.0	20.0
2013	7809	15.0	23.3	0.0	23.5	0.0	23.5
2014	7629	13.7	22.3	0.0	22.2	0.0	22.2
2015	7404	11.1	20.6	0.0	16.0	0.0	16.0
2016	7211	11.6	19.7	0.0	18.2	0.0	18.2
2017	6963	12.3	20.2	0.0	18.2	0.0	18.2
2018	6757	13.6	20.6	0.0	21.4	0.0	21.4
2019	6598	11.4	18.9	0.0	18.2	0.0	18.2

**Supplementary Table 2: GP retention rates between 2007 and 2019.**

Year	N practices	Mean	SD	Median	IQR	25th percentile	75th percentile
2007	8075	94.7	13.9	100.0	0.0	100.0	100.0
2008	8053	94.2	14.1	100.0	0.0	100.0	100.0
2009	8077	93.0	15.5	100.0	0.0	100.0	100.0
2010	8056	93.0	15.3	100.0	0.0	100.0	100.0
2011	8008	92.1	15.8	100.0	11.1	88.9	100.0
2012	7924	91.6	16.0	100.0	14.3	85.7	100.0
2013	7808	91.1	15.1	100.0	16.2	83.8	100.0
2014	7629	90.8	15.2	100.0	16.7	83.3	100.0
2015	7404	92.3	14.4	100.0	12.5	87.5	100.0
2016	7211	92.5	14.4	100.0	12.5	87.5	100.0
2017	6963	92.3	13.9	100.0	12.5	87.5	100.0
2018	6757	92.0	13.4	100.0	14.3	85.7	100.0
2019	6597	92.5	13.0	100.0	12.5	87.5	100.0

**Supplementary Table 3: Number of practices excluded and distribution of general practitioner (GP) turnover rates**

Year	N practices excluded	N practices where turnover was not missing	Mean	SD	Median	IQR	25th percentile	75th percentile
2007	118	113	166.4	126.7	200.0	150.0	50.0	200.0
2008	177	169	127.5	118.0	200.0	200.0	0.0	200.0
2009	222	201	115.9	129.8	100.0	200.0	0.0	200.0
2010	265	253	111.5	113.0	66.7	200.0	0.0	200.0
2011	299	222	125.7	130.7	200.0	200.0	0.0	200.0
2012	164	155	163.9	177.0	200.0	200.0	0.0	200.0
2013	153	144	204.0	201.7	200.0	0.0	200.0	200.0
2014	244	222	199.8	143.0	200.0	0.0	200.0	200.0
2015	219	204	233.6	151.0	200.0	0.0	200.0	200.0
2016	345	274	195.7	79.8	200.0	0.0	200.0	200.0
2017	391	283	217.3	260.4	200.0	0.0	200.0	200.0
2018	369	221	208.8	92.9	200.0	0.0	200.0	200.0
2019	269	182	196.2	72.4	200.0	0.0	200.0	200.0

Supplementary Table 4: Persistent high turnover (&gt;10%) over 2, 3, 4, or 5 consecutive years.

Year	N pract active 2 years	N prac persist high turnover 2 years	% prop prac persist high turnover 2 years	N pract active 3 years	N prac persist high turnover 3 years	% prop prac persist high turnover 3 years	N pract active 4 years	N prac persist high turnover 4 years	% prop prac persist high turnover 4 years	N pract active 5 years	N prac persist high turnover 5 years	% prop prac persist high turnover 5 years
2007	7906	478	6.0	7798	210	2.7	7691	109	1.4	7601	57	0.7
2008	7862	628	8.0	7753	272	3.5	7664	132	1.7	7550	70	0.9
2009	7845	758	9.7	7749	361	4.7	7633	189	2.5	7463	117	1.6
2010	7845	832	10.6	7725	408	5.3	7547	231	3.1	7345	142	1.9
2011	7785	1001	12.9	7601	521	6.9	7392	302	4.1	7158	139	1.9
2012	7615	1189	15.6	7404	629	8.5	7170	274	3.8	6911	141	2.0
2013	7411	1307	17.6	7175	523	7.3	6917	263	3.8	6711	144	2.1
2014	7178	1022	14.2	6917	446	6.4	6712	230	3.4	6548	109	1.7
2015	6897	834	12.1	6692	378	5.6	6527	190	2.9	6527	98	1.5
2016	6742	860	12.8	6576	404	6.1	6576	202	3.1			
2017	6589	966	14.7	6589	417	6.3						
2018	6590	946	14.4									
2019												

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses
<b>Results</b>		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Report numbers of outcome events or summary measures over time
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period



Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
<b>Other information</b>		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.