

# BMJ Open Trends and determinants of clinical staff retention in the English NHS: a double retrospective cohort study

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## ABSTRACT

**Objectives** To investigate how demographic, contractual and organisational factors are related to the retention of hospital workers in the English NHS. The study will specifically examine the trends in age-retention profiles.

**Design** A double retrospective cross-cohort study using administrative data on senior and specialty doctors, nurses and midwives who were included in the 2009 and 2014 payrolls of all English NHS hospital Trusts. These individuals were tracked over time until 2019 to examine the associations between sociodemographic characteristics and the retention of hospital workers in each cohort. Logistic regressions were estimated at the individual worker level to analyse the data. Additionally, a multilevel panel regression was performed using linked payroll-survey data to investigate the association between hospital organisation characteristics and the retention of clinical staff.

**Setting** Secondary acute and mental healthcare NHS hospital Trusts in England.

**Participants** 70 777 senior doctors (specialty and specialist doctors and hospital consultants) aged 30–70, and a total of 448 568 between nurses and midwives of any grade aged 20–70, employed by English NHS Trusts.

**Primary outcome measures** Employee retention, measured through binary indicators for stayers and NHS leavers, at 1-year and 5-year horizons.

**Results** Minority doctors had lower 1-year retention rates in acute care than white doctors, while minority nurses and midwives saw higher retention. Part-time roles decreased retention for doctors but improved it for nurses. Fixed-term contracts negatively impacted both groups' retention. Trends diverged for nurses and doctors from 2009 to 2014—nurses' retention declined while doctors' 5-year retention slightly rose. Engagement boosted retention among clinical staff under 51 years of age in acute care. For nurses over 50, addressing their feedback was positively associated with retention.

**Conclusions** Demographic and contractual factors appear to be stronger predictors of hospital staff retention than organisational characteristics.

## INTRODUCTION

The English National Health Service (NHS) employs more than 1.3 million people, and it is the largest public sector employer in Europe.<sup>1</sup> Against the backdrop of growing demand for healthcare,<sup>2–4</sup> despite its sizeable

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Captures staff retention over both short-term and long-term periods.
- ⇒ Covers the universe of nurses, midwives and senior/specialty doctors across all English NHS hospitals.
- ⇒ Relies on administrative payroll records to measure retention, avoiding self-reporting bias.
- ⇒ Cannot ascertain causality from observational analysis.
- ⇒ Unable to track clinical staff's career destinations after leaving the NHS and does not cover the COVID-19 period.

workforce, the English NHS has been under pressure due to high employee turnover, low retention and the increasing number of vacancies.<sup>3 5 6</sup> In September 2022, data from NHS England revealed that there were over 9000 vacant medical positions in secondary care.<sup>4</sup>

The secular changes in population demographics, such as the progressing ageing of the English labour force, are reflected also in the NHS workforce, with almost half of the medical staff aged 45 and over, and 20% of the nursing workforce aged 56 and above.<sup>7 8</sup> Thus, any effective strategy aimed at relieving the NHS workforce pressures, for example, through the retention of existing employees or recruitment of new staff, must take into account how the distribution of workers' characteristics affects the retention of NHS workers.<sup>9</sup>

Despite its substantial workforce, the NHS faces numerous challenges, including high employee turnover, low retention rates and an increasing number of job vacancies. For instance, in spite of significant increases in activity pressures, the full-time equivalent (FTE) number of registered nurses and health visitors employed in the NHS in England experienced only a modest growth of approximately 0.5% (equivalent to 1300 FTE positions) between July 2017 and July 2018.<sup>3</sup> This highlights the ongoing workforce

crisis and emphasises that it is also a retention crisis.<sup>10</sup> Moreover, many doctors are actively seeking alternative employment options, exploring opportunities abroad, taking breaks from their medical careers or even opting for early retirement. For example, the percentage of foundation year 2 doctors transitioning directly into training has significantly declined from 83.1% in 2010 to only 35% in 2019.<sup>11</sup> In addition, with a considerable portion of medical staff aged 45 and above, along with a significant percentage of nursing personnel aged 56 and above, it becomes crucial to comprehend how the distribution of workers' characteristics impacts their retention.<sup>12</sup> Notably, there has been a substantial increase in the number of doctors opting for early retirement from the NHS, surpassing the previous count by more than threefold over the past 13 years (2007–2021).<sup>12</sup> A survey conducted by the British Medical Association (BMA) in late 2018 revealed that 60% of hospital consultants expressed their intention to retire at or before the age of 60.<sup>13</sup> Finally, it is important to explore the relationship between retention and the types of contractual arrangements, such as part-time versus full-time appointments and fixed-term versus permanent appointments, because nurses and doctors are subject to different types of work pressures and may have different preferences for these work attributes.

The aim of this study is threefold. In the first instance, this research investigates the demographic, contractual and organisational factors associated with the retention of clinical staff in English NHS hospital Trusts, both in acute and mental healthcare (MH), over short-term (1 year) and long-term (5 years) time horizons. By shedding light on the complex relationships between these factors and the retention of NHS clinical workers in the pre-COVID-19 period, the study findings can inform tailored policy solutions to boost the retention of such NHS workers during non-pandemic times. Moreover, the study examines trends in age-retention profiles<sup>14</sup> and retention rates across two cohorts of senior doctors, nurses and midwives using longitudinal workforce data. These findings provide new evidence on the relationship between the retention of NHS clinical workers and the age of existing staff, which is a key risk factor to account for when planning for the long-term and medium-term supply of both hospital doctors and nurses. Finally, the study analyses the relationship between NHS clinical staff 1 year retention within the same hospital organisation and factors such as staff engagement and job satisfaction, split by young and mid-career versus late career workers.

## MATERIALS AND METHODS

### Study design and data sources

This study follows two cohorts of NHS clinical workers over a 5-year period, using administrative data. The NHS Electronic Staff Records (ESRs), a monthly employee-level payroll data collected from the English Department of Health and Social Care, are used in the analysis.

Cohort-level data for senior doctors, that is, hospital consultants and 'specialty and specialist grade' (SAS) doctors, and nursing staff (ie, nurses and midwives) are constructed using the longitudinal ESR from 2009 to 2019. Their retention measures are based on a snapshot of the clinical workforce employed in the English public healthcare sector in the financial years 2009/2010 (2009 cohort) and 2014/2015 (2014 cohort), and their retention is measured following the clinical workers until 2019/2020 financial year.

Individual-level NHS Staff Survey (NSS) data for the years from 2014/2015 to 2019/2020 have been matched to ESR individual-level data using the following linkage variables: year, NHS Trust and categories for the age of NHS workers (21–30; 31–40; 41–50; 51–65; over 65 years). Overall, the sample covers all employment spells that occurred during the financial years 2014/2015 and 2019/2020, before the onset of the COVID-19 pandemic.

### Study participants

The analysis sample is restricted to 70 777 senior doctors between 30 and 70 years old, and 448 568 nursing staff aged between 20 and 70 years when stability at workplace is studied; when leaving the NHS is the outcome variable studied, the age is capped at 63, that is, before the legal retirement age. Junior doctors are excluded from the sample due to their statutory rotations across hospital Trusts during their medical training. Clinical workers covered by non-standard employment contracts (ie, neither fixed-term nor permanent) are also excluded from the analysis, representing 0.6% of the senior doctors' sample and 0.3% of the nursing one.

### Study outcomes and variables

To evaluate clinical workers' retention within the NHS hospital sector, we consider two distinct outcome variables defined at the individual level: stability (ie, NHS stayers) and NHS leaving indicator. These variables respectively assess the duration of individual employment within the same hospital organisation and the entire English NHS sector over 1 and 5 years. In the context of this study, stability is considered as a measure of employment continuity, taking the value of 1 if the individual employment spell continued in the same hospital up to a given time horizon. The NHS leaving indicator, instead, identifies an individual employment break from the entire NHS hospital sector, taking the value of 1 if the employment spell ended within the specified time horizon and the employee was not employed at any other NHS hospital for the subsequent 6 months.

To account for the confounding factors, we include hospital Trust indicators as control variables to control for the specific Trust where the worker is employed. In the model, we also control for demographic factors such as gender (categorical, takes the value 1 if female, and 0 otherwise), age, ethnic background (white, black, Asian, mixed, other, missing) and nationality of the clinical worker (British, European, Overseas). As noted in

the 'Study participants' section, the age of doctors and nursing staff is restricted between 30 and 70, and 20 and 70, respectively. Age enters logistic regression as separate dummy variables and, to avoid predicting the outcome perfectly, we group the end points of the age spectrums through binning. This means that doctors who are older than 67 are counted as 67, and nurses aged below 25 are categorised as 24 and those above 67 as 67. Additionally, the job characteristics taken into consideration include the type of appointment (part-time or full-time), the type of contract (fixed-term, locum or permanent) and the medical specialty of the worker (acute, dental, gynaecology, imaging, oncology, pathology, primary care, psychiatry, surgery, other). Type and length of appointment are based on the mode of the value in workers' employment spells.

In a secondary analysis, organisational attributes measured from the NSS are incorporated into the model to take into account perceived work-environment for employees below and above the age of 50. These factors are the overall staff engagement, the share of staff satisfied or very satisfied with the recognition of their work, the shares of staff agreed or strongly agreed to have adequate materials, supplies, equipment and staff to do their job, to have effective communication between senior management and staff, that senior managers try to involve staff in important decisions and that senior managers act on staff feedback.

### Data analysis

To assess the impact of demographic and job characteristics on retention outcomes, logistic regressions are conducted using the *logit* command in Stata V.17 (StataCorp LLC) separately for each combination of cohort, staff group and care setting. Specifically, the study examines the 2009 and 2014 cohorts, as well as different staff groups (nurses and doctors) and care settings (acute care and MH). This approach allows for the estimation of associations between these variables and retention outcomes at each time horizon. The resulting predicted retention probabilities are plotted against the age of clinical workers to understand how retention behaviour changes by age in each cohort and over time.

Missing data for individual characteristics were grouped into residual categories of the control variables during the analysis. Categorical variables are presented as frequencies in the summary statistics tables. Continuous variables are presented as means with SD. Standard t-statistic tests are used for inference on the statistical significance of the logit model estimates. Statistical significance is defined as a p value <0.01, unless otherwise specified.

To formally test for statistically significant changes in the coefficients of interest (ie, changes in workforce retention, age profile and in the associations with other demographic factors) across the 2009 and 2014 cohorts, additional logistic regressions are estimated. These model specifications have all the covariates interacted with a 2014 dummy variable and, also in this case, are estimated

separately by staff group (nursing staff; senior doctors) and type of hospital Trust organisation (acute care, MH).

Finally, the associations of NHS workers' retention with organisational factors at the Trust level by workers' age are obtained by estimating additional multilevel logistic regressions by occupational group and NHS Trust type (acute, MH). The logistic regressions use the same set of variables and hospital Trust indicators as the baseline cohort-level models. However, in addition to these variables, the regressions also incorporate organisational factors as of measured from the NSS survey, which are interacted with age category indicators of the workers. The outcome variable used in these regressions is the binary indicator representing whether a worker remains employed at the same NHS Trust at a 1-year horizon.

### Patient and public involvement

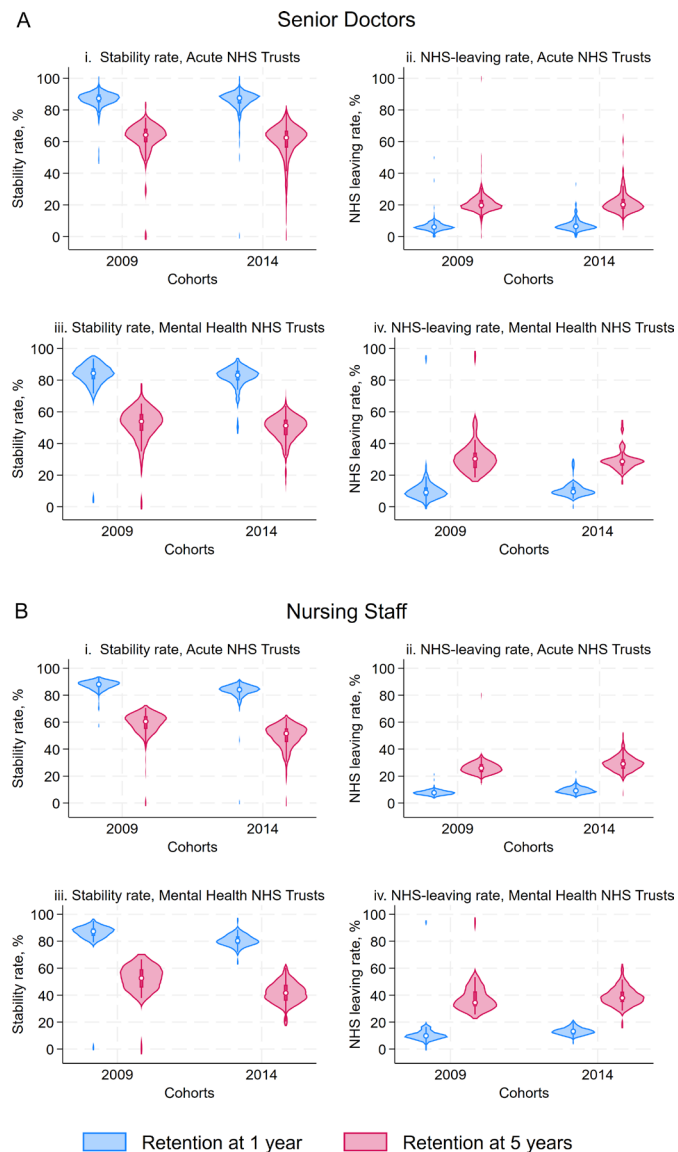
Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

### RESULTS

Online supplemental table 1 presents the summary statistics of the demographic and job characteristics of the 2009 and 2014 cohorts of senior doctors and nursing staff working in acute and MH Trusts. Staff composition in terms of demographics and job traits remained roughly the same across cohorts within the same staff group and healthcare setting. Within the NHS hospital sector, nursing emerges as a predominantly female occupation, with as many as 9 out of 10 nursing staff in acute care being female. However, when considering senior doctors, female staff constitute approximately 40% of the total. This stark contrast highlights the gender disparities within these healthcare professions.<sup>15–17</sup>

Most of the clinical workforce is British, with a white ethnic background. Asian employees account for almost 20% of the senior medical staff. A lower share (10%) is associated with the nursing workforce. The share of doctors and nurses from Overseas is higher than that from European countries. A considerable number of senior doctors in acute care hospitals held a part-time appointment (23%), which is even higher in MH organisations (32%). The opposite holds for nurses, with 38%–41% of the acute care staff and 27%–29% of the MH staff holding a part-time post across our two cohorts of study. Generally, around 9% and 3% of the medical workforce is under a fixed-term and a locum contract, respectively. Instead, the percentage of nursing with a fixed-term post stood at 2%. Finally, no nurse holds a locum contract, a type of employment relationship exclusively aimed at the medical personnel.

Figure 1 presents the distributions of retention rates for 2009 and 2014 cohorts for senior doctors (panel A) and nursing staff (panel b) in acute and MH care Trusts. For both clinical staff groups, stability decreased with longer employment, with only around 50% of staff continuing



**Figure 1** Distribution of retention among senior doctors and nursing staff in 2009 and 2014 cohorts. NHS, National Health Service.

their work in the same Trust after 5 years in 2009. The declining trend in retention rates was especially prominent among nursing staff. Notably, in MH Trusts, only 42% of nurses from the 2014 cohort remained with the same organisation for 5 years, compared with 54% in the 2009 cohort as illustrated in the bottom figure of figure 1B.

### Association of demographic and contractual factors with senior doctors' retention outcomes

Online supplemental table 2 presents the association of demographic and job characteristics with the stability measures at 1 and 5 years, and their change over time, for the two cohorts of senior doctors working in acute and MH Trusts, respectively. The table reports the estimated logit ORs together with their associated p values in parentheses.

Senior doctors from ethnic minority backgrounds working in acute care Trusts were less likely to stay in the same Trust compared with white senior doctors, particularly in the 2009 cohort for the first year of employment. For instance, black senior doctors from the 2009 cohort recorded a 32.8% lower probability of remaining employed for a year in the same hospital organisation than white senior doctors. This difference is statistically significant at the 1% level. The OR associated with Asian doctors in the fully interacted model reported in column 5 of online supplemental table 2 shows that 1 year retention within the same hospital improved by 21.2% between 2009 and 2014, compared with the 2009–2014 change recorded by white senior doctors. We do not find a strong association between ethnicity and retention of senior doctors in MH hospitals in either cohort. Senior doctors from Europe or Overseas working in acute care were less likely to be retained within the same Trust both in the 2009 and 2014 cohorts.

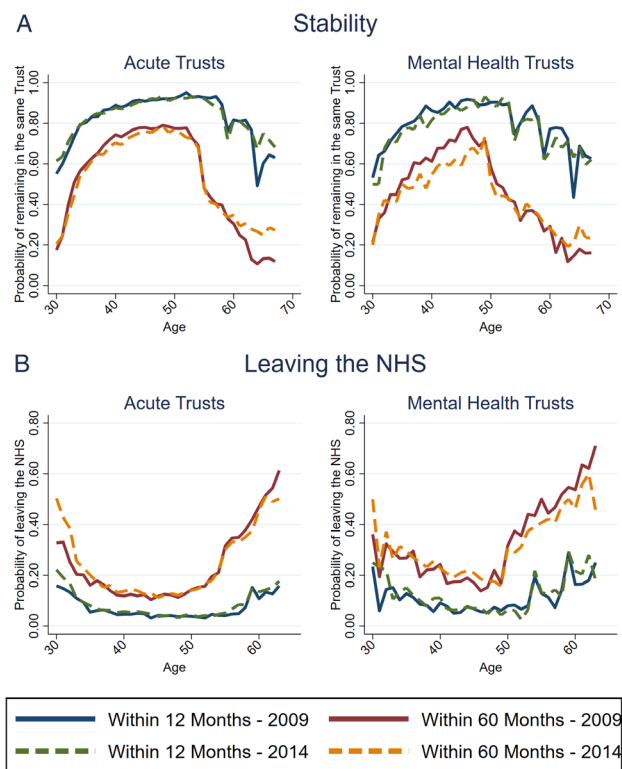
Senior doctors on part-time contracts had lower odds of staying in the same Trust for at least 5 years, both in the acute and MH sector. Fixed-term contracts were linked to lower stability at all employment lengths for senior doctors, but the odds of working in the same acute care hospital for at least 5 years increased by 38% for doctors under fixed-term contracts from 2009 to 2014. The same trend applied to doctors on locum contracts in an acute care Trust.

Imaging and surgery senior doctors had higher odds of staying for 5 years compared with the reference category of medicine, while general acute, primary care and psychiatry doctors were less likely to be retained. Stability patterns in most specialties remained consistent between the 2009 and 2014 cohorts, except for pathology, which had lower retention odds in the 2014 cohort.

Online supplemental table 3 presents the senior doctors' ORs for leaving the NHS at different time periods. Asian senior doctors in both healthcare settings were less likely to leave the NHS at a 5-year horizon. Compared with British senior doctors, all other nationalities were more likely to leave the NHS at any length of employment, but the odds of leaving the NHS following 5-year employment were 17% lower in the 2014 cohort compared with the 2009 cohort in acute care hospitals. A similar pattern was observed for the 2009 cohort working in MH Trusts for doctors from Overseas, but there was no significant association between leaving the NHS after 5 years and the European indicator.

### Age-retention profiles of senior doctors

The top panels of figure 2 depict the age-stability profile of senior doctors from the 2009 and 2014 cohorts in both acute care and MH Trusts. The profiles show an inverted U-shape, with higher stability at 1 year compared with 5 years, which is more pronounced across cohorts and hospital types. In acute care hospitals, there was a slight change in the age-stability profile between the 2009 and 2014 cohorts. Older age groups had a higher probability



**Figure 2** Age-retention profile of senior doctors, 2009 and 2014 cohorts. NHS, National Health Service

of remaining in the same hospital in the 2014 cohort compared with the 2009 cohort. A similar pattern was observed for doctors in MH Trusts, but in the 2014 cohort, the probability of staying in the same Trust during prime age (35–50) was lower compared with the 2009 cohort. In MH Trusts, the highest predicted stability for senior doctors at 5 years was around 80% at age 45 in the 2009 cohort, while in the 2014 cohort, it was just above 70% for doctors close to 50 years old.<sup>18 19</sup>

The bottom panels of figure 2 depict the NHS leavers' age profile. The latter was flatter in the first year of employment, particularly in acute care settings. For senior doctors in MH Trusts, the probability of leaving the NHS was slightly higher among younger senior doctors in the 2014 cohort; the leaving probability declined until early retirement age and increased rapidly beyond early retirement age, with a slightly lower leaving probability at 5 years horizon for senior doctors aged 50 and above in the 2014 cohort.

### Association of demographic and contractual factors with nursing staff's retention outcomes

The ORs for the stability of nurses and midwives in acute and MH Trusts are shown in online supplemental table 4, along with the ORs for the difference in demographic and job traits of the 2009 and 2014 cohorts.

Being female was positively associated with remaining in the same Trust, with odds for stayers slightly higher the longer the employment durations. Among the 2014

cohort, a female nurse working in acute Trust for at least 5 years was 1.28 times more likely to stay in her organisation compared with male nurses, but the same ratio dropped to 1.07 for MH nurses. In MH Trusts, the odds of female nurses and midwives staying in the same organisation showed significant decline in 2014 compared with the 2009 cohort, both at 1-year and 5-year horizons (last two columns of online supplemental table 4).

Asian nurses had a higher likelihood of retention in their Trust for all durations compared with white nursing staff in acute care Trusts. For an Asian nurse from the 2009 cohort, the likelihood of remaining employed in the same hospital organisation over a 5-year horizon was almost 75% higher than that associated with a white nurse. However, in the 2014 cohort, black nurses were less likely to remain in the same Trust for all durations. A similar pattern was held for MH nurses in the 2014 cohort. Coming from Overseas was associated with higher odds for the stability of nursing staff in both cohorts in acute care Trusts, but the same evidence was not found for MH Trusts, where the odds of nursing stability were about 1.3 times higher in the 2014 cohort than in the 2009.<sup>20 21</sup>

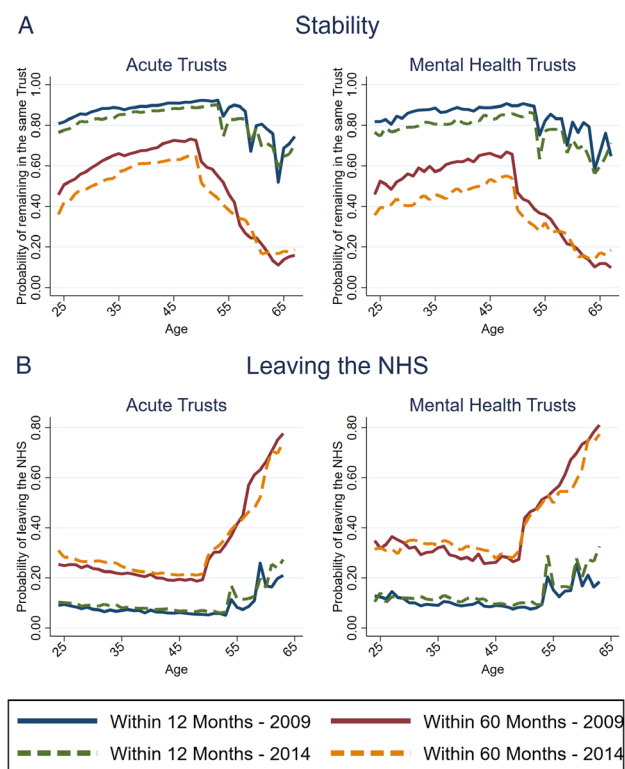
Part-time work was found to be positively associated with the stability of nurses for all time periods in both healthcare settings, while working on a fixed-term contract decreased the odds of remaining in the same Trust for longer periods.

Compared with general medicine nursing, the odds of remaining in the same hospital were significantly higher for nurses whose primary area was obstetrics and surgery, particularly in the 2014 cohort. On the other hand, nurses in general acute, primary care and psychiatry were less likely to stay in the same Trust for longer periods. There was a sharp decline in the odds of stability for nurses working in primary care by 50% between the 2009 and 2014 cohorts.

Online supplemental table 5 presents the ORs from the logistic regressions for the probability of leaving the NHS for the 2009 and 2014 cohorts of nursing staff, in acute and MH Trusts. Most of the predictors for leaving the NHS are consistent with the stayers' probability. In contrast to stability, coming from abroad increased the probability of leaving the NHS in both cohorts, and this was more pronounced for Overseas nursing staff working in MH hospitals.

### Age-retention profiles of nurses and midwives

Nursing staff exhibited lower employment stability at 5 years compared with 1 year, and an inverted U-shape pattern was observed for stability at 5 years in both acute care and MH care Trusts for nurses and midwives (figure 3, top panels). The predicted probability of staying in the same Trust increased with age, reached the top just before retirement age, and decreased sharply afterwards. Both at 1 and 5 years, the probability of nursing staff's stability was higher in the 2009 cohort than in the 2014 cohort. Despite the gap between the predicted retention between the 2009 and 2014 cohorts in terms of stability,



**Figure 3** Age-retention profile of nurses and midwives, 2009 and 2014 cohorts. NHS, National Health Service

predictions were similar for nursing staff approaching retirement age at 5-year stability.

Unlike the age-stability profile of nurses, their NHS leaving behaviour did not change much across cohorts. As shown in the bottom panels of [figure 3](#), the predicted probability of leaving the NHS was slightly higher in 2014 than in 2009 for younger nurses, while the predicted probability was lower for nursing staff approaching retirement age. As shown on the bottom-right panel for MH Trusts, the predicted probability of leaving the NHS was lower among nurses below the age of 30 in 2014 compared with the same group in 2009. In both cohorts and types of hospitals, the probability of a permanent exit from employment in the NHS at a 1-year (5 year) horizon reached a minimum at about 53 years (50 years) and then it steeply increased.

### Organisational factors affecting the retention of nurses and doctors

The age-retention profiles in [figures 2 and 3](#) show that the retention of NHS hospitals' senior doctors and nurses declined after age 50, both in terms of lower stability within hospitals and higher NHS leaving rates. It is important to understand whether the fall in retention of older age workers is associated with organisational factors that are under the control of NHS hospital managers and policymakers. To investigate this question, online supplemental table 6 reports the ORs from complementary multilevel logistic regressions by occupational group

and NHS Trust type (acute, MH), which used some of the organisational factors measured by the annual NSS data. The results show that a higher engagement score was the main positive factor associated with the retention of nurses and midwives aged below 51 years in both acute and MH hospitals; engagement was also positively associated with the retention of senior and SAS hospital consultants below 51 years in acute care. Having Trust line managers acting on staff feedback was the only other organisational feature which presented a meaningful and statistically significant positive association with retention at 1-year horizon for nurses and midwives above the age of 51 in acute care hospitals. All other ORs were not statistically significant, except for a significant negative association between retention and understaffing in MH Trusts for doctors younger than 51 years.

### DISCUSSION

This paper investigates the retention of clinical staff working in English NHS hospital Trusts at 1 and 5 years of employment, within the same organisation and within the NHS. Using the administrative payroll data from the Department of Health and Social Care, the empirical analysis is based on two cohorts of senior doctors, specialty and associate specialist doctors, nurses and midwives who were employed in 2009/2010 and 2014/2015 and have been followed until March 2020. This study makes several significant contributions to the existing literature addressing the urgent issue of workforce retention and its impact on the NHS. The NHS faces great challenges in retaining valuable staff amidst high turnover, ageing demographics and growing care demands. With doctor trainee retention rates plummeting over the past decade and over half of consultants anticipating early retirement, this analysis sounds the alarm on unsustainable workforce dynamics that may jeopardise NHS future functioning.<sup>3 10 22</sup>

The study's results reveal heterogeneous drivers of retention between occupations and care settings. Ethnic minority status showed little association with senior doctor turnover, except among Asian physicians. However, black nurses in acute care faced consistently higher odds of leaving their Trusts over time compared with white peers. This disparity persisted for longer-tenured black nursing staff. In MH, the impacts of workers' ethnicity were less consistent. These findings underscore the importance of disaggregating retention challenges and solutions both by occupation and specialisation rather than taking a one-size-fits-all approach. Staff retention depends also on their origin and staff group. British senior doctors have higher retention rates, while Overseas nurses are more likely to remain in the same Trust. This could relate to visa regulations that make it difficult for Overseas staff to change jobs.<sup>23</sup>

We found that a part-time appointment is positively associated with nurse retention, likely by providing flexibility, especially for those with care duties. Instead, a

part-time appointment is negatively associated with retention of doctors, who may consider such appointment type as precarious and not fulfilling. Retention is lowest for younger and older staff, who are more mobile. Younger staff have lower opportunity costs to change jobs. Older staff retention is linked to retirement, as those who were 51+ have the highest rates of leaving the NHS. As doctors approached retirement age, the probability of staying in the same Trust decreased significantly.<sup>18 19</sup> Senior doctor retention was stable between 2009 and 2014, while nurse retention deteriorated across most ages. Positive associations with retention at 1 year are found only for two hospital organisational factors: the engagement of nurses/midwives/SAS doctors under 51; and the satisfaction with line managers acting on feedback and late career nurses (over 51).

Limited evidence shows that other organisational factors like communication or recognition improve retention. These findings align with previous research<sup>10 24</sup> that use similar methods and data. This study sheds light on the changing demographics of the workforce, particularly the ageing population, and how it manifests within the NHS. With a considerable portion of medical staff aged 45 and above, along with a significant percentage of nursing personnel aged 56 and above, it becomes crucial to comprehend how the distribution of workers' characteristics impacts their retention.<sup>12 25</sup> The poor retention observed reinforces calls for healthcare organisations to develop more effective reward systems aimed at increasing staff retention, as argued in earlier work.<sup>15 26</sup> Despite significant increases in activity pressures, the FTE number of registered nurses and health visitors employed in the NHS in England experienced only a modest growth of approximately 0.5% (equivalent to 1300 FTE positions) between July 2017 and July 2018.<sup>3</sup> This highlights the ongoing workforce crisis and emphasises that it is also a retention crisis.<sup>10</sup>

In conclusion, this study meaningfully contributes to research on NHS workforce retention. It tackles pressing retention challenges, including high turnover, demographic shifts and evolving work contracts. The results highlight the need for strategies, incentives and policies to improve retention rates and ensure the NHS's future sustainability. This study also highlights that proximity to the early retirement and state pension ages, as well as the flexibility of appointment and contract duration, are the primary predictors of retention among NHS clinical professionals. The findings shed light on the individual drivers of retention, encompassing both stability within the NHS and the decision to quit the NHS hospital sector. Furthermore, the study reveals the changes in retention patterns over time, providing valuable insights for identifying and addressing future retention challenges within the NHS.

### Strengths and limitations

The study boasts several strengths. It uses comprehensive and high-quality administrative and survey data encompassing the entire population of nursing and medical staff employed by NHS hospital Trusts. By examining

retention outcomes at both the organisational level (stability indicator) and the system-wide level (NHS attrition indicator), the study offers a comprehensive understanding of retention dynamics. Additionally, the analysis encompasses both acute and MH hospitals, providing insights beyond studies that solely focus on system-wide exit indicators applied to acute care settings. The retrospective cohort-level analysis allows for tracking the same workers over an extended period, enhancing the study's longitudinal perspective.

However, it is important to acknowledge the study's limitations. Due to its observational nature, causal interpretations cannot be attributed to the findings. Future research should delve into investigating the factors and mechanisms that potentially exert a causal impact on the retention of NHS hospital nurses and doctors. The data only extend until 2019/2020 and does not capture major recent events likely to impact NHS staff retention. For instance, Brexit has reduced staff recruitment from the EU; the COVID-19 epidemic has increased staff workload, burnout and safety risks; and recent industrial actions underscore NHS staff discontent with pay and working conditions. These unmeasured factors may worsen retention beyond what is reflected in the pre-2020 data. In addition, some relevant organisational characteristics like Care Quality Commission (CQC) ratings, trust size and local housing costs were unavailable but could also influence retention. Finally, while extensive individual and hospital-level variables were included, residual confounding is still possible.

Overall, this study contributes to the existing literature by providing valuable insights into the predictors of retention among NHS clinical professionals. The findings, coupled with the study's strengths and limitations, offer a foundation for future research and the development of strategies to improve retention within the NHS, which might be adopted to develop and deliver the proposal expressed in the NHS Long Term Workforce Plan.<sup>27</sup>

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**Contributors** GM, the lead investigator, author and guarantor of the study, has designed the empirical analysis, advised on data creation and management and contributed to writing the article. CN, senior researcher and coauthor, has contributed by literature search and writing the article. MS, research fellow and coauthor, has contributed to the data creation and management, the empirical analysis and to writing the article. MM, lecturer and coauthor, has contributed to the data creation and management, the empirical analyses and to writing the article.

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**Competing interests** None declared.

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**Data availability statement** Data may be obtained from a third party and are not publicly available.

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#### REFERENCES

- NHS England. NHS long-term plan. 2019.
- Rachet-Jacquet L, Rocks S, Charlesworth A. Long-term projections of health care funding, bed capacity and workforce needs in England. *Health Policy* 2023;132:104815.
- Buchan J, Gershlick B, Charlesworth A, et al. *A critical moment: NHS staffing trends, retention and attrition*. London: Health Foundation, 2019.
- NHS Digital. NHS vacancy statistics England April 2015-September 2022: experimental Statistics. 2022.
- Buchan J, Charlesworth A, Gershlick B, et al. *Rising pressure: the NHS workforce challenge*. Health Foundation, 2017.
- Buchan J, Gershlick B, Charlesworth A, et al. *Falling short: the NHS workforce challenge*. Health Foundation, 2019.
- British Medical Association. *Supporting an ageing medical workforce*. 2019.
- Royal College of Nursing. *The NMC register: 1 April 2022–31 March 2023*. 2023.
- Anderson M, O'Neill C, Macleod Clark J, et al. Securing a sustainable and fit-for-purpose UK health and care workforce. *The Lancet* 2021;397:1992–2011.
- Kelly E, Stoye G, Warner M. *Factors associated with staff retention in the NHS acute sector*. Institute for Fiscal Studies, 2022.
- Lok P. Planning has to adjust to doctors taking a break after foundation years, says review. *BMJ* 2022;376:o396.
- Moberly T. Doctors' early retirement has trebled since 2008. *BMJ* 2021;373:n1594.
- British Medical Association. *Consultants pension survey 2019*. 2019. Available: <https://web.archive.org/web/20190305072744/www.bma.org.uk/collective-voice/committees/consultants-committee/priorities/consultants-pension-survey>
- Murphy KM, Welch F. Empirical age-earnings profiles. *Journal of Labor Economics* 1990;8:202–29.
- Appleby J. Gender pay gap in England's NHS: little progress since last year. *BMJ* 2019;365:l2089.
- Woodhams C, Williams M, Dacre J, et al. Retrospective observational study of ethnicity-gender pay gaps among hospital and community health service doctors in England. *BMJ Open* 2021;11:e051043.
- Critchley J, Schwarz M, Baruah R. The female medical workforce. *Anaesthesia* 2021;76 Suppl 4:14–23.
- Kelly E, Stoye G, Warner M. *Patterns of less-than-full-time working by NHS consultants*. The Institute for Fiscal Studies, 2023.
- Magennis P, Begley A, Dhariwal DK, et al. Oral and Maxillofacial surgery (OMFS) consultant workforce in the UK: reducing consultant numbers resulting from recruitment issues, pension pressures, changing job-plans, and demographics when combined with the COVID backlog in elective surgery, requires urgent action. *Br J Oral Maxillofac Surg* 2022;60:14–9.
- Woolf K, Papineni P, Lagrata S, et al. Retention of ethnic minority staff is critical to resolving the NHS workforce crisis. *BMJ* 2023;380:p541.
- Gillin N, Smith D. Overseas recruitment activities of NHS trusts 2015–2018: findings from FOI requests to 19 acute NHS trusts in England. *Nurs Inq* 2020;27:e12320.
- Marufu TC, Collins A, Vargas L, et al. Factors influencing retention among hospital nurses: systematic review. *Br J Nurs* 2021;30:302–8.
- Nursing Times. *Overseas nurses 'trapped' in UK contracts with exorbitant exit fees*. 2022.
- Moscelli G, Sayli M, Mello M. Staff engagement, coworkers' complementarity and employee retention: evidence from English NHS hospitals. *SSRN Journal* 2022.
- Telling WA. Age profile of NHS workers in occupational physician clinics. *Occup Med (Chic Ill)* 2021;71:147–53.
- Palmer W, Rolewicz L. Placed at a premium? The use of recruitment and retention pay supplements to address staffing shortfalls, in Nuffield trust report; 2022.
- NHS. *NHS long term workforce plan*. 2023.



Table 1. Summary statistics of selected characteristics of doctors and nursing staff

	Senior Doctors				Nursing Staff			
	Acute care		Mental Health		Acute care		Mental Health	
	2009	2014	2009	2014	2009	2014	2009	2014
Female	0.31	0.35	0.42	0.46	0.92	0.92	0.75	0.80
Age	46.55	46.78	46.27	46.89	40.15	40.89	43.10	43.87
<i>Ethnicity</i>								
White	0.60	0.58	0.57	0.54	0.76	0.77	0.78	0.80
Black	0.03	0.03	0.04	0.05	0.07	0.07	0.12	0.11
Asian	0.26	0.29	0.29	0.32	0.10	0.10	0.04	0.03
Mixed	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
Other	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.01
<i>Nationality</i>								
British	0.76	0.74	0.70	0.70	0.85	0.83	0.88	0.91
European	0.07	0.09	0.09	0.10	0.03	0.07	0.03	0.03
Overseas	0.17	0.17	0.20	0.20	0.12	0.10	0.09	0.06
<i>Job traits</i>								
Fixed-Term	0.07	0.10	0.08	0.09	0.02	0.02	0.02	0.03
Locum	0.03	0.02	0.04	0.03	-	-	-	-
Part-Time	0.23	0.22	0.32	0.33	0.41	0.38	0.27	0.29
Workers	43,418	51,936	6,680	6,975	256,744	304,244	62,011	70,961
Employment	45,306	54,172	6,898	7,239	265,175	318,449	63,170	73,162
Spells								

Notes. Summary statistics from the estimation sample for the main retention measure, stability.

Table 2. Association of demographic and job characteristics with the stability of senior doctors in Acute and Mental Health care Trusts, odds ratios

	Acute care NHS Trusts						Mental Health Care NHS Trusts					
	Cohort 2009		Cohort 2014		Change 2009 - 2014		Cohort 2009		Cohort 2014		Change 2009 - 2014	
	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years
Female	0.902 (0.011)	0.970 (0.278)	0.920 (0.030)	0.956 (0.060)	1.020 (0.704)	0.986 (0.704)	0.928 (0.286)	1.010 (0.866)	0.902 (0.168)	0.905 (0.050)	0.972 (0.783)	0.897 (0.167)
Ethnicity (ref: White)												
Black	0.672* (0.000)	0.890 (0.126)	0.745* (0.003)	0.922 (0.232)	1.109 (0.441)	1.035 (0.708)	0.662 (0.039)	0.901 (0.481)	1.011 (0.952)	1.053 (0.728)	1.526 (0.132)	1.169 (0.379)
Asian	0.753* (0.000)	0.901* (0.009)	0.912 (0.034)	1.034 (0.307)	1.212* (0.005)	1.147* (0.003)	0.927 (0.440)	1.035 (0.667)	0.823 (0.058)	1.166 (0.027)	0.888 (0.411)	1.127 (0.202)
Mixed	0.641* (0.000)	0.843 (0.067)	0.911 (0.428)	0.953 (0.572)	1.421 (0.045)	1.130 (0.322)	0.974 (0.928)	1.121 (0.490)	0.787 (0.393)	0.893 (0.523)	0.809 (0.582)	0.797 (0.353)
Other	0.674* (0.000)	0.912 (0.167)	0.889 (0.120)	1.042 (0.516)	1.318 (0.025)	1.143 (0.128)	0.701 (0.086)	0.941 (0.731)	1.038 (0.867)	1.463* (0.008)	1.480 (0.149)	1.555 (0.034)
Nationality (ref: British)												
EU-EEA	0.547* (0.000)	0.657* (0.000)	0.617* (0.000)	0.631* (0.000)	1.127 (0.143)	0.960 (0.511)	0.713 (0.030)	0.893 (0.321)	1.002 (0.988)	1.012 (0.888)	1.405 (0.107)	1.133 (0.348)
Overseas	0.823* (0.000)	0.751* (0.000)	0.850* (0.000)	0.726* (0.000)	1.033 (0.623)	0.966 (0.510)	0.701* (0.010)	0.754* (0.005)	0.871 (0.184)	0.899 (0.234)	1.241 (0.186)	1.192 (0.103)
Appointment: Part-time Contract (ref: Permanent)	1.124 (0.029)	0.707* (0.000)	1.075 (0.132)	0.754* (0.000)	0.956 (0.521)	1.066 (0.212)	0.875 (0.129)	0.770* (0.000)	0.935 (0.492)	0.790* (0.003)	1.068 (0.627)	1.027 (0.799)
Fixed-term	0.093* (0.000)	0.072* (0.000)	0.097* (0.000)	0.099* (0.000)	1.040 (0.657)	1.382* (0.001)	0.130* (0.000)	0.139* (0.000)	0.133* (0.000)	0.206* (0.000)	1.021 (0.884)	1.482 (0.123)
Locum	0.053* (0.000)	0.043* (0.000)	0.080* (0.000)	0.137* (0.000)	1.507* (0.000)	3.206* (0.000)	0.119* (0.000)	0.115* (0.000)	0.134* (0.000)	0.224* (0.000)	1.132 (0.674)	1.960 (0.041)
Speciality (ref: Medicine)												
Oncology	1.739 (0.010)	1.250 (0.035)	1.007 (0.962)	1.105 (0.380)	0.579 (0.024)	0.884 (0.416)						
Dental/Oral	0.892 (0.294)	0.866 (0.046)	1.020 (0.856)	0.935 (0.316)	1.143 (0.354)	1.080 (0.424)						
General Acute	0.742* (0.001)	0.665* (0.000)	0.911 (0.233)	0.819* (0.000)	1.227 (0.052)	1.232 (0.014)						
Imaging	1.420* (0.000)	1.264* (0.000)	1.111 (0.223)	1.079 (0.217)	0.783 (0.056)	0.853 (0.070)						
Obstetrics/Gynaecology	0.932 (0.390)	1.054 (0.362)	0.918 (0.379)	1.033 (0.563)	0.985 (0.899)	0.980 (0.794)						
Pathology	1.091 (0.286)	0.976 (0.694)	0.718* (0.001)	0.680* (0.000)	0.659* (0.000)	0.697* (0.000)						
Surgery	1.093 (0.074)	1.208* (0.000)	1.053 (0.272)	1.184* (0.000)	0.964 (0.588)	0.980 (0.614)						
Primary Care	0.656 (0.104)	0.550* (0.005)	0.378* (0.000)	0.320* (0.000)	0.576 (0.069)	0.583 (0.062)	1.453 (0.135)	0.597 (0.039)	0.681 (0.146)	0.703 (0.073)	0.469 (0.027)	1.179 (0.508)
Psychiatry	0.522 (0.087)	0.464* (0.000)	1.312 (0.496)	0.425* (0.000)	2.515 (0.097)	0.917 (0.784)	0.863 (0.385)	0.797 (0.196)	0.851 (0.605)	1.124 (0.560)	0.987 (0.966)	1.410 (0.112)
Mental Health							1.478 (0.160)	0.642 (0.071)	1.331 (0.363)	1.119 (0.597)	0.900 (0.784)	1.741 (0.025)
Constant	4.484* (0.000)	1.111 (0.700)	3.771* (0.000)	0.591* (0.008)			2.457 (0.103)	0.765 (0.637)	3.399 (0.091)	0.339 (0.103)		
Observations	45,304	44,852	54,011	54,026	99,315	98,878	6898	6898	7239	7239	14137	14137
Pseudo R <sup>2</sup>	0.246	0.236	0.196	0.194	0.219	0.213	0.223	0.191	0.175	0.122	0.198	0.157

Notes. Odds ratios from logit estimations with associated p-values in parentheses. All models include age and month dummies. Speciality recorded as "other", ethnicity and nationality "not stated" are included in analyses but not shown here \* p<0.01

Table 3. Association of demographic and job characteristics with the NHS attrition of senior doctors in Acute and Mental Health care Trusts, odds ratios

	Acute care NHS Trusts						Mental Health Care NHS Trusts					
	Cohort 2009		Cohort 2014		Change 2009 - 2014		Cohort 2009		Cohort 2014		Change 2009 - 2014	
	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years
Female	1.001 (0.989)	0.970 (0.417)	0.965 (0.493)	0.961 (0.174)	0.965 (0.617)	0.990 (0.844)	0.916 (0.321)	0.928 (0.225)	0.875 (0.119)	0.857* (0.007)	0.955 (0.714)	0.924 (0.346)
Ethnicity (ref: White)												
Black	1.178 (0.228)	0.995 (0.947)	1.213 (0.096)	1.167 (0.030)	1.029 (0.865)	1.174 (0.128)	1.513 (0.049)	0.930 (0.649)	1.300 (0.300)	1.141 (0.488)	0.859 (0.644)	1.227 (0.374)
Asian	0.880 (0.034)	0.791* (0.000)	0.926 (0.205)	0.842* (0.000)	1.053 (0.563)	1.065 (0.274)	0.874 (0.316)	0.741* (0.000)	1.021 (0.874)	0.730* (0.000)	1.169 (0.411)	0.985 (0.891)
Mixed	1.280 (0.105)	1.043 (0.711)	1.073 (0.606)	1.082 (0.409)	0.839 (0.391)	1.037 (0.794)	0.949 (0.897)	0.893 (0.553)	1.395 (0.249)	1.075 (0.725)	1.471 (0.471)	1.204 (0.469)
Other	1.314* (0.009)	1.054 (0.407)	1.049 (0.607)	1.082 (0.195)	0.909 (0.115)	0.798 (0.116)	0.862 (0.846)	0.946 (0.370)	0.854 (0.992)	1.002 (0.120)	0.755 (0.866)	0.884 (0.568)
Nationality (ref: British)												
EU-EEA	2.393* (0.000)	1.745* (0.000)	1.962* (0.000)	1.657* (0.000)	0.820 (0.041)	0.950 (0.480)	1.715* (0.003)	1.355 (0.011)	1.057 (0.746)	0.997 (0.972)	0.616 (0.019)	0.736 (0.026)
Overseas	1.614* (0.000)	1.902* (0.000)	1.609* (0.000)	1.586* (0.000)	0.997 (0.976)	0.834* (0.002)	1.844* (0.000)	1.820* (0.000)	1.374 (0.032)	1.400* (0.001)	0.745 (0.135)	0.770 (0.020)
Appointment: Part-time Contract (ref: Permanent)	1.418* (0.000)	1.914* (0.000)	1.220* (0.002)	1.710* (0.000)	0.860 (0.082)	0.893 (0.034)	1.388* (0.010)	1.622* (0.000)	1.359* (0.006)	1.508* (0.000)	0.979 (0.891)	0.930 (0.503)
Fixed-term	6.128* (0.000)	3.104* (0.000)	6.498* (0.000)	3.349* (0.000)	1.060 (0.509)	1.079 (0.425)	4.616* (0.000)	2.309* (0.000)	4.804* (0.000)	2.240* (0.000)	1.041 (0.799)	0.970 (0.852)
Locum	6.897* (0.000)	2.636* (0.000)	6.881* (0.000)	2.438* (0.000)	0.998 (0.985)	0.925 (0.493)	5.138* (0.000)	2.708* (0.000)	4.000* (0.000)	1.389 (0.136)	0.779 (0.352)	0.513 (0.027)
Speciality (ref: Medicine)												
Oncology	0.760 (0.260)	0.986 (0.908)	0.897 (0.621)	0.849 (0.106)	1.180 (0.635)	0.861 (0.416)						
Dental/Oral	1.703* (0.000)	1.438* (0.000)	1.026 (0.804)	1.135 (0.117)	0.603* (0.002)	0.789 (0.012)						
General Acute	1.598* (0.000)	1.412* (0.000)	1.224 (0.026)	1.339* (0.000)	0.766 (0.031)	0.948 (0.554)						
Imaging	0.735 (0.038)	0.798* (0.001)	0.796 (0.027)	0.858 (0.032)	1.084 (0.666)	1.075 (0.429)						
Obstetrics/Gynaecology	1.118 (0.263)	1.109 (0.067)	1.130 (0.166)	1.126 (0.040)	1.010 (0.933)	1.016 (0.841)						
Pathology	1.016 (0.889)	1.004 (0.955)	1.093 (0.448)	1.130 (0.067)	1.075 (0.631)	1.125 (0.194)						
Surgery	0.960 (0.509)	0.901* (0.004)	0.859* (0.006)	0.880* (0.001)	0.894 (0.188)	0.977 (0.641)						
Primary Care	2.638* (0.000)	1.956* (0.001)	4.016* (0.000)	3.147* (0.000)	1.523 (0.254)	1.609 (0.092)	0.698 (0.323)	1.612 (0.105)	1.429 (0.266)	1.203 (0.280)	2.047 (0.155)	0.746 (0.306)
Psychiatry	1.506 (0.097)	1.290 (0.225)	0.944 (0.885)	1.341 (0.139)	0.627 (0.303)	1.039 (0.883)	0.891 (0.645)	0.928 (0.474)	0.808 (0.805)	0.808 (0.180)	1.042 (0.917)	0.702 (0.119)
Mental Health							0.435 (0.057)	1.127 (0.638)	0.685 (0.273)	0.651 (0.049)	1.575 (0.386)	0.577 (0.082)
Constant	0.036* (0.000)	0.098* (0.000)	0.088* (0.000)	0.431* (0.000)			0.145* (0.002)	0.267* (0.000)	0.113* (0.002)	0.861 (0.804)		
Observations	43991	44101	52443	52469	96548	96570	6632	6651	6968	6980	13600	13631
Pseudo R <sup>2</sup>	0.158	0.139	0.155	0.131	0.157	0.134	0.196	0.148	0.133	0.080	0.164	0.113

Notes. Odds ratios from logit estimations with associated p-values in parentheses. All models include age and month dummies. Speciality recorded as "other", ethnicity and nationality "not stated" are included in analyses but not shown here \* p<0.01

Table 4. Association of demographic and job characteristics with the stability of nurses and midwives in Acute and Mental Health care Trusts, odds ratios

	Acute care NHS Trusts						Mental Health Care NHS Trusts					
	Cohort 2009		Cohort 2014		Change 2009 - 2014		Cohort 2009		Cohort 2014		Change 2009 - 2014	
	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years
Female	1.236*	1.349*	1.205*	1.280*	0.975	0.949	1.179*	1.193*	1.047	1.065*	0.888*	0.893*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.394)	(0.035)	(0.000)	(0.000)	(0.099)	(0.010)	(0.005)	(0.000)
Ethnicity (ref: White)												
Black	0.952	0.840*	0.782*	0.874*	0.821*	1.041	1.060	1.125	0.806*	0.997	0.761*	0.887
	(0.299)	(0.000)	(0.000)	(0.006)	(0.000)	(0.425)	(0.478)	(0.139)	(0.003)	(0.969)	(0.001)	(0.137)
Asian	1.596*	1.748*	1.412*	1.624*	0.884*	0.929	1.071	1.144	1.053	1.232*	0.984	1.077
	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.062)	(0.388)	(0.073)	(0.410)	(0.001)	(0.820)	(0.317)
Mixed	0.979	0.907	0.887*	0.929	0.906	1.024	0.904	0.988	0.898	0.916	0.993	0.927
	(0.712)	(0.046)	(0.008)	(0.026)	(0.129)	(0.644)	(0.280)	(0.884)	(0.221)	(0.212)	(0.952)	(0.434)
Other	1.461*	1.776*	1.319*	1.633*	0.903	0.920	1.238	1.372*	1.270	1.531*	1.025	1.116
	(0.000)	(0.000)	(0.000)	(0.000)	(0.206)	(0.081)	(0.132)	(0.000)	(0.020)	(0.000)	(0.883)	(0.429)
Nationality (ref: British)												
EU-EEA	0.912	0.903*	0.727*	0.627*	0.798*	0.694*	0.897	0.933	0.887	0.910	0.990	0.976
	(0.057)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.125)	(0.253)	(0.051)	(0.117)	(0.902)	(0.710)
Overseas	1.119*	1.111*	1.184*	1.120*	1.058	1.008	0.919	0.813	0.945	1.046	1.028	1.287*
	(0.010)	(0.007)	(0.000)	(0.002)	(0.215)	(0.840)	(0.313)	(0.024)	(0.373)	(0.643)	(0.734)	(0.006)
Appointment: Part-time	1.266*	1.210*	1.279*	1.151*	1.010	0.951*	1.169*	1.041	1.158*	1.053	0.991	1.012
	(0.000)	(0.000)	(0.000)	(0.000)	(0.655)	(0.002)	(0.000)	(0.201)	(0.000)	(0.041)	(0.859)	(0.752)
Contract: Fixed-term	0.229*	0.203*	0.245*	0.269*	1.068	1.327*	0.166*	0.165*	0.163*	0.158*	0.980	0.955
	(0.000)	(0.000)	(0.000)	(0.000)	(0.323)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.853)	(0.719)
Speciality (ref: Medicine)												
Oncology	0.935	0.886	0.900	1.023	0.962	1.155						
	(0.390)	(0.051)	(0.246)	(0.724)	(0.775)	(0.110)						
Dental/Oral	1.039	0.570*	0.540	0.804	0.520	1.410						
	(0.823)	(0.001)	(0.173)	(0.407)	(0.170)	(0.265)						
General Acute	0.952	0.901*	0.990	0.930*	1.040	1.032						
	(0.064)	(0.000)	(0.664)	(0.000)	(0.224)	(0.255)						
Imaging	0.923	0.914	0.977	1.048	1.058	1.146						
	(0.426)	(0.200)	(0.760)	(0.341)	(0.622)	(0.078)						
Obstetrics/Gynaecology	1.168*	1.103*	1.218*	1.114*	1.043	1.010						
	(0.000)	(0.001)	(0.000)	(0.000)	(0.471)	(0.777)						
Pathology	0.990	1.010	0.952	0.941	0.961	0.931						
	(0.897)	(0.860)	(0.446)	(0.318)	(0.681)	(0.313)						
Surgery	1.057	1.042	1.062*	1.102*	1.004	1.057						
	(0.022)	(0.053)	(0.002)	(0.000)	(0.876)	(0.023)						
Primary Care	1.913*	0.961	0.797*	0.480*	0.417*	0.499*	0.903	0.979	0.960	0.855	1.063	0.874
	(0.000)	(0.560)	(0.000)	(0.000)	(0.000)	(0.000)	(0.696)	(0.786)	(0.603)	(0.024)	(0.824)	(0.180)
Psychiatry	0.538	0.422*	0.819	0.552*	1.524	1.308	0.600	0.933	1.045	1.351*	1.741	1.448*
	(0.099)	(0.000)	(0.062)	(0.000)	(0.294)	(0.354)	(0.096)	(0.519)	(0.694)	(0.000)	(0.087)	(0.005)
Mental Health							0.586	0.920	1.071	1.362*	1.827	1.481*
							(0.076)	(0.484)	(0.609)	(0.000)	(0.056)	(0.009)
Constant	2.341*	0.349*	1.723*	0.286*			6.563*	0.622*	3.367*	0.353*		
	(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)		
Observations	265175	261207	317635	317635	582810	578842	63170	63170	73162	73162	136332	136332
Pseudo R <sup>2</sup>	0.059	0.085	0.056	0.087	0.061	0.092	0.112	0.099	0.057	0.072	0.087	0.095

Notes. Odds ratios from logit estimations with associated p-values in parentheses. All models include age and month dummies. Speciality recorded as "other", ethnicity and nationality "not stated" are included in analyses but not shown here \*p<0.01

Table 5. Association of demographic and job characteristics with the NHS attrition of nurses and midwives in Acute and Mental Health care Trusts, odds ratios

	Acute care NHS Trusts						Mental Health Care NHS Trusts					
	Cohort 2009		Cohort 2014		Change 2009 - 2014		Cohort 2009		Cohort 2014		Change 2009 - 2014	
	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years	1 year	5 years
Female	0.797*	0.734*	0.777*	0.755*	0.975	1.028	0.858*	0.856*	0.908*	0.882*	1.058	1.030
	(0.000)	(0.000)	(0.000)	(0.000)	(0.526)	(0.347)	(0.000)	(0.000)	(0.009)	(0.000)	(0.332)	(0.411)
Ethnicity (ref: White)												
Black	0.896	1.001	1.369*	1.146*	1.528*	1.145*	0.731*	0.757*	1.126	0.943	1.540*	1.246*
	(0.032)	(0.980)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.048)	(0.248)	(0.000)	(0.006)
Asian	0.517*	0.508*	0.672*	0.604*	1.300*	1.191*	0.828	0.754*	0.788*	0.669*	0.952	0.888
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.024)	(0.000)	(0.000)	(0.000)	(0.603)	(0.120)
Mixed	1.027	1.044	1.258*	1.119*	1.224	1.071	0.880	0.848	0.964	0.995	1.095	1.173
	(0.687)	(0.398)	(0.000)	(0.004)	(0.012)	(0.258)	(0.274)	(0.055)	(0.756)	(0.953)	(0.572)	(0.131)
Other	0.570*	0.527*	0.768*	0.653*	1.347*	1.241*	0.683*	0.672*	0.643*	0.591*	0.942	0.880
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)	(0.757)	(0.324)
Nationality (ref: British)												
EU-EEA	1.327*	1.268*	1.643*	1.725*	1.238*	1.360*	1.150	1.025	1.117	1.081	0.972	1.055
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.054)	(0.674)	(0.142)	(0.146)	(0.767)	(0.464)
Overseas	1.234*	1.403*	1.153*	1.208*	0.935	0.861*	1.276*	1.502*	1.370*	1.261*	1.074	0.840
	(0.000)	(0.000)	(0.000)	(0.000)	(0.194)	(0.000)	(0.008)	(0.000)	(0.000)	(0.001)	(0.418)	(0.011)
Appointment: Part-time	0.993	1.104*	0.981	1.152*	0.988	1.043*	0.947	1.095*	1.029	1.164*	1.087	1.063
	(0.707)	(0.000)	(0.230)	(0.000)	(0.598)	(0.005)	(0.184)	(0.001)	(0.462)	(0.000)	(0.149)	(0.081)
Contract: Fixed-term	3.543*	2.427*	3.366*	2.089*	0.950	0.861*	4.615*	3.093*	4.444*	2.532*	0.963	0.819
	(0.000)	(0.000)	(0.000)	(0.000)	(0.394)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.694)	(0.078)
Speciality (ref: Medicine)												
Oncology	0.978	1.067	1.013	0.960	1.036	0.899						
	(0.789)	(0.303)	(0.851)	(0.434)	(0.717)	(0.178)						
Dental/Oral	1.438	2.500*	2.928	1.763	2.036	0.705						
	(0.065)	(0.000)	(0.040)	(0.097)	(0.196)	(0.351)						
General Acute	1.050	1.087*	1.053	1.105*	1.003	1.016						
	(0.121)	(0.000)	(0.034)	(0.000)	(0.934)	(0.542)						
Imaging	1.198	1.201*	1.134	1.035	0.946	0.862						
	(0.049)	(0.008)	(0.191)	(0.562)	(0.678)	(0.067)						
Obstetrics/Gynaecology	0.752*	0.853*	0.810*	0.925*	1.077	1.084						
	(0.000)	(0.000)	(0.000)	(0.002)	(0.102)	(0.010)						
Pathology	1.017	1.010	1.118	1.078	1.098	1.067						
	(0.848)	(0.865)	(0.153)	(0.245)	(0.327)	(0.428)						
Surgery	1.028	1.069*	1.056	1.029	1.027	0.963						
	(0.296)	(0.003)	(0.012)	(0.089)	(0.432)	(0.165)						
Primary Care	0.550*	1.030	1.240*	1.472*	2.255*	1.430*	1.078	1.151	1.095	1.333*	1.016	1.158
	(0.000)	(0.630)	(0.000)	(0.000)	(0.000)	(0.000)	(0.804)	(0.139)	(0.200)	(0.000)	(0.960)	(0.218)
Psychiatry	1.906*	1.892*	1.444	1.368*	0.757	0.723	1.597	1.304	1.201	1.193	0.752	0.915
	(0.001)	(0.000)	(0.018)	(0.008)	(0.262)	(0.073)	(0.163)	(0.018)	(0.021)	(0.010)	(0.412)	(0.522)
Mental Health							1.740	1.399*	1.221	1.209*	0.702	0.864
							(0.096)	(0.006)	(0.014)	(0.006)	(0.294)	(0.306)
Constant	0.174*	0.635*	0.212*	0.713*			0.104*	0.504*	0.108*	0.556*		
	(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)		
Observations	263668	263668	315562	315562	579230	579230	62620	62635	72310	72310	134945	134945
Pseudo R <sup>2</sup>	0.047	0.074	0.047	0.062	0.048	0.068	0.111	0.091	0.054	0.058	0.081	0.073

Notes. Odds ratios from logit estimations with associated p-values in parentheses. All models include age and month dummies. Speciality recorded as "other", ethnicity and nationality "not stated" are included in analyses but not shown here \*p<0.01

Table 6. Association of retention at one year within Trust and organisational factors, by hospital workers' age

	Nurses & Midwives		Senior & SAS Doctors	
	(1)	(2)	(3)	(4)
	Acute Trusts	MH Trusts	Acute Trusts	MH Trusts
Overall engagement score: 50 years and below	1.153*** (0.000)	1.280*** (0.000)	1.202*** (0.000)	1.076 (0.091)
Overall engagement score: Above 50 years	1.017 (0.627)	1.106 (0.169)	1.061 (0.252)	0.990 (0.784)
% Satisfied/v. satisfied with recognition for good work: 50 years and below	1.022 (0.817)	0.828 (0.455)	0.771 (0.069)	1.325 (0.092)
% Satisfied/v. satisfied with recognition for good work: Above 50 years	1.113 (0.547)	1.358 (0.434)	1.086 (0.471)	0.782 (0.153)
% Agree/st.agree to have adequate materials/supplies/equipment to work: 50 years and below	1.208 (0.125)	1.393 (0.181)	0.888 (0.341)	1.151 (0.347)
% Agree/st.agree to have adequate materials/supplies/equipment to work: Above 50 years	0.756 (0.088)	0.938 (0.865)	0.983 (0.871)	0.813 (0.252)
% Agree/st.agree enough staff at NHS Trust to do job: 50 years and below	0.817 (0.099)	1.111 (0.621)	0.989 (0.932)	0.671** (0.034)
% Agree/st.agree enough staff at NHS Trust to do job: Above 50 years	1.107 (0.594)	0.940 (0.871)	1.243 (0.185)	0.914 (0.714)
% Agree/st.agree communications between senior management & staff is effective: 50 years and below	0.867 (0.194)	0.656 (0.173)	0.895 (0.544)	0.886 (0.589)
% Agree/st.agree communications between senior management & staff is effective: Above 50 years	1.094 (0.724)	1.301 (0.604)	0.813 (0.270)	1.608 (0.083)
% Agree/st.agree senior managers try to involve staff in important decision: 50 years and below	1.172 (0.445)	0.591 (0.163)	1.144 (0.374)	1.027 (0.876)
% Agree/st.agree senior managers try to involve staff in important decision: Above 50 years	1.375 (0.205)	0.568 (0.192)	0.839 (0.291)	0.997 (0.989)
% Agree/st.agree senior managers act on staff feedback: 50 years and below	0.810 (0.050)	1.265 (0.535)	1.035 (0.830)	0.933 (0.732)
% Agree/st.agree senior managers act on staff feedback: Above 50 years	1.633** (0.025)	1.964 (0.186)	1.088 (0.671)	0.772 (0.335)
Observations	1,684,482	369,905	307,062	36,463
Pseudo R <sup>2</sup>	0.044	0.033	0.112	0.060

Notes. Odds ratios from logistic regressions including all variables as in models reported in Tables 2 and 4, and hospital Trust indicators with associated p-values in parentheses. Outcome variable: binary indicator for individual worker still employed at the same NHS Trust at a one-year horizon. Period: financial years 2014/15 – 2019/20. Data: ESR individual data (2014-2019) and individual level NHS Staff Survey data (2014/15 – 2019/20), linked by NHS Trust and age categories of NHS workers (21-30; 31-40; 41-50; 51-65; over 65). Standard errors clustered at the NHS Trust level. \*p<0.01 \*\* p<0.05 \*\*\*p<0.1.

## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2-3
Objectives	3	State specific objectives, including any prespecified hypotheses	1,2-3
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	1,2-3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	1, 3-5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	1, 3-5
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	1, 3-5
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	4-5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	3-5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	3-5
		(b) Describe any methods used to examine subgroups and interactions	3-5
		(c) Explain how missing data were addressed	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	

Continued on next page

<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) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	6
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	6
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	6-10
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	10-12
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	10-12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-12
<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	14

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**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 [www.strobe-statement.org](http://www.strobe-statement.org).