

Factors influencing variation in participation in the National Diabetes Audit and the impact on the Quality and Outcomes Framework indicators of diabetes care management

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ABSTRACT

Objective Participation in the National Diabetes Audit (NDA) has become a contractual requirement for all general practices in England and is used as part of the assessment framework for sustainability and transformation partnership (STP) footprints. The study aimed to investigate general practice-related factors which may influence participation in the NDA, and the impact that participation in the NDA may have on diabetes management and patient care.

Research design A cross-sectional analysis of routine primary care data from 45 725 646 patients aged 17+ years registered across 7779 general practices in England was performed using logistic regression. The main outcome measures included general practice voluntary participation in the NDA, general practice-related factors (practice size, deprivation, diabetes prevalence, geographic area, practice population age) and diabetes management outcomes (cholesterol, blood pressure, hemoglobin A1c (HbA1c)).

Results Participation in the NDA differed significantly according to practice size ($t(7653)=-9.93$, $p=0.001$), level of deprivation ($\chi^2(9)=36.17$, $p<0.0001$), diabetes prevalence ($p<0.0001$), practice population age ($p<0.0001$), and geographic area ($\chi^2(26)=676.9$, $p<0.0001$). In addition, the Quality and Outcomes Framework diabetes indicator HbA1c (OR 1.01, CI 1.0 to 1.01, $p=0.0001$) but not cholesterol ($p=0.055$) or blood pressure ($p=0.76$) was independently associated with NDA participation when controlling for practice-related factors.

Conclusion Variation in NDA participation exists. It is suggested that some practices may need additional support when submitting data to the NDA and that NDA participation may have an impact on diabetes outcomes. However, the use of NDA outcomes as a measure of progress with diabetes care by STPs is still unclear and further investigation is needed.

INTRODUCTION

Without adequate management, diabetes can be a debilitating disease with increased risk of stroke and cardiovascular disease, as well as complications such as kidney damage,

Significance of this study

What is already known about this subject?

- ▶ Diabetes is a public health priority requiring adequate management and monitoring at the primary care level to prevent complications.
- ▶ The National Diabetes Audit (NDA) is used as part of the assessment framework for sustainability and transformation partnerships to monitor diabetes management in general practice and is now a contractual requirement for all general practices in England.
- ▶ Evidence suggests that sharing data among peers improves performance, but little evidence exists examining the factors which may influence practice participation in the NDA and the impact that participation may have on diabetes outcomes and patient care.

What are the new findings?

- ▶ General practices set in more deprived areas with smaller patient list sizes, a higher proportion of elderly patients, and greater diabetes prevalence were significantly less likely to participate in the NDA.

How might these results change the focus of research or clinical practice?

- ▶ It may be possible for commissioners to address these inequalities and identify general practices that need additional support and resources to submit to the NDA or other mandatory and non-mandatory clinical audits.
- ▶ NDA participation may have an impact on diabetes outcomes in primary care; however, although these markers of diabetes care used in the NDA are well-established measures at a patient level, their ability to discriminate between organizations or areas at a population level is less certain and requires further evaluation.

blindness, nerve damage, and amputation. Treatment of diabetes currently accounts for 10% of the total National Health Service

(NHS) budget, but this is projected to rise to 17% by 2035/2036.¹ Effective management of blood glucose, cholesterol, and blood pressure can significantly lower the risk of these complications in both type 1 and type 2 diabetes.²⁻⁷

Evidence also suggests that general practice (GP)-related factors may be as important as patient or organizational characteristics when influencing diabetic patient care and outcome.^{8,9} This is especially pertinent as there has been a move in recent decades to review the majority of patients with diabetes largely in primary care.^{10,11} Practice-level factors which may influence diabetes management can include case load/resources (eg, practice size, disease prevalence, and practice population age), level of deprivation, and geographic location.¹²⁻¹⁷ It is important therefore to monitor changes and improvements to diabetes management and outcome in primary care.

The National Diabetes Audit (NDA) was established in 2004 to monitor disease management and outcome. It is now used as part of the assessment framework for sustainability and transformation partnership (STP) footprints. From April 2017 submission of data to the NDA became a contractual requirement for all GPs in England.¹⁸ Despite the fact that the NDA is now a contractual requirement, it may still be possible that some practices struggle to submit sufficient data of an adequate quality.

In light of these contractual changes and the importance of effective diabetes management on population health, the study aimed to explore the following:

1. Factors which may influence participation in the NDA.
2. The impact that participation in the NDA may have on diabetes management and patient care.

METHODS

Design

This is a cross-sectional analysis of routinely collected and publicly available primary care data.

Setting

The setting is in 7779 GPs in England who submitted data in 2014/2015 to the NHS Quality and Outcomes Framework (QOF).

Participants

The participants of the study were 45 725 646 patients aged 17+ years registered at 7779 GPs in England.

Measures

NDA participation grouping was derived from NDA data submission in 2014/2015. The NDA is part of the National Clinical Audit Programme commissioned by the Healthcare Quality Improvement Partnership and funded by NHS England. The NDA is delivered by NHS Digital partnership with Diabetes UK and is supported by Public Health England. The NDA measures the effectiveness of diabetes healthcare against the National Institute for Health and Care Excellence (NICE) Clinical Guidelines and NICE Quality Standards in England

and Wales as part of routine care. Participation of GPs in the NDA was historically on an opt-out basis, with practices actively choosing not to take part; however, participation was changed to a voluntary, opt-in basis for the first time in 2014/2015.¹⁸ Participation rates have varied over time, and the 2014/2015 data set was used for this study as the voluntary opt-in participation process ensured equal grouping and few missing data which may otherwise have biased the analysis. The NDA collates diabetes management scores for blood pressure, cholesterol, and hemoglobin A1c (HbA1c). In order to assess patient care in practices that participated and did not participate in the NDA, QOF diabetes scores were used in this analysis.

Predictor variables

Practice size and diabetes prevalence were obtained from the NHS QOF 2014/2015 data set. The QOF is an incentivized voluntary process for all GP surgeries in England and was introduced as part of the GP contract in 2004. The QOF contains three main domains (clinical, public health and public health-additional services). Each clinical domain has a disease register created by collating data from patient records to provide an overview of those coded appropriately with the relevant condition; those that have the disease but do not meet certain criteria are reported as exceptions. Each domain also consists of a set of achievement measures, known as indicators, against which practices score points according to their level of achievement. Practices are awarded points if their achievement in clinical areas is over a certain threshold.¹⁹ Practice (list) size indicates the number of patients registered at a particular practice. Diabetes prevalence indicates the percentage of patients aged 17 years and over with diabetes mellitus, as recorded on the practice disease register.

Deprivation data were obtained from the Index of Multiple Deprivation (IMD) 2015 scores, derived from patient postcode for the resident population in each local authority as reported by the Department for Communities and Local Government.²⁰ IMD 2015 measures relative levels of deprivation in small areas of England using 37 separate indicators organized across seven distinct domains of deprivation (income, employment, health and disability, education skills and training, barriers to housing and services, living environment, and crime).²¹ IMD 2015 scores and deciles are defined at the lower layer super output areas in England.

Practice population age was defined as the percentage of patients in each practice aged 65 years and over as of April 2015. The data are published by NHS Digital and are extracted as a quarterly snapshot in time from the GP payments system maintained by the Health and Social Care Information Centre.²²

Geographic area was defined by NHS Area Team Code boundaries in 2014/2015.

Outcome variables

Diabetes management scores for cholesterol, blood pressure, and HbA1c were obtained from NHS QOF 2014/2015.¹⁹ The indicators used include the following:

- ▶ Blood pressure management target (DM003): patients with diabetes, on the disease register, in whom the last blood pressure reading (measured in the preceding 12 months) is 140/80 mm Hg or less. Patients who did not meet the target include exceptions.
- ▶ Cholesterol management target (DM004): patients with diabetes, on the disease register, whose last measured total cholesterol (measured within the preceding 12 months) is 5 mmol/L or less. Patients who did not meet the target include exceptions.
- ▶ HbA1c management target (DM007): patients with diabetes, on the disease register, in whom the last IFCC-HbA1c is 59 mmol/mol or less in the preceding 12 months. Patients who did not meet the target include exceptions.

Statistical analyses

Differences in practice size, practice population age, diabetes prevalence, deprivation decile, and NHS Area Team between practices that participated and did not participate in the NDA were analyzed using t-test, Wilson Score CIs, and χ^2 . Three logistic regression models were used to investigate the associations between diabetes management outcomes (patients who met the QOF management target vs patients who did not meet the QOF management target) for blood pressure (DM003), cholesterol (DM004), HbA1c (DM007), and NDA participation. The model was weighted for disease register size and was adjusted for practice size, practice population age, deprivation decile, geographic area, and diabetes prevalence. Practices with missing data (n=2) were excluded from the analyses. Statistical analysis was performed using IBM SPSS Statistics V.23 and RStudio. All data are routinely collected and currently available in the public domain.

RESULTS

Data were available for 7779 practices in England. Very small practices with a list size fewer than 900 patients were excluded from the analysis (n=21). One additional practice was excluded due to insufficient data available for QOF indicators, and two further practices were excluded because practice population age and deprivation score data were not available. In total, 45 725 646 patients aged 17+ years on the GP register from 7755 GPs in England were included in the final analysis. Of these 7755 practices, 58% (n=4498) participated in the 2014/2015 NDA.

Practice demographic characteristics

In total, there were 2 912 749 patients with diabetes mellitus in the study. Practices had an average of 376 patients (SD=232.9) registered with diabetes mellitus, with a range from 3 to 2358 patients. Overall prevalence

of diabetes mellitus was 6.4%, with a range from 0.3% at a practice in Bristol, North Somerset, and South Gloucestershire, to 20.4% at a practice in Birmingham and Solihull. Practice size ranged from 901 to 54 589, with a mean size of 7323 (SD=44210.1). From these practices 9 752 575 patients (17.1%) were aged 65 years and over; this ranged from 0% at a practice in Bristol, North Somerset, and South Gloucestershire, to 92.5% at a practice in Greater Manchester. IMD varied from 3.2 to 66.5 across all practices in England, with a mean of 23.7 (SD=11.9).

NDA participation and QOF achievement

The NDA collects patient data on blood pressure, cholesterol and HbA1c. These data were available for all practices which took part in the NDA. NDA diabetes management scores were significantly correlated with QOF diabetes management scores for blood pressure (r=0.81, p<0.0001), cholesterol (r=0.51, p<0.0001), and HbA1c (r=0.72, p<0.0001).

The QOF diabetes points achievement thresholds are outlined in table 1. QOF points and payments are rewarded to practices if achievement (measurement of specific management indicators) is above a designated level.¹⁹ For the QOF blood pressure indicator (DM003), the rewardable threshold range is 38%–78%. There were 2758 patients from 20 practices (0.3% of practices) who fell below this threshold lower limit from blood pressure measurement, while 25% of practices (n=1939) performed above the threshold limit. For the QOF cholesterol indicator (DM004), the rewardable threshold range is 40%–75%. There were 422 patients from 5 practices (0.1% of practices) who fell below the threshold limit, and 24.2% (n=1876) of practices performed above the threshold limit. For the QOF HbA1c indicator (DM007), the rewardable threshold range is from 35% to 75%. There were 5262 patients from 33 practices in England (0.4% of practices) who did not achieve this management target, while 1.4% of practices (n=5262) exceeded the management target for this particular indicator.

QOF achievement and NDA participation are illustrated in table 2. In total, more than two million patients on the diabetes register (71%) met the QOF target for blood pressure and had a blood pressure reading of 140/80 mm Hg or less in the last 12 months. Of those who met the QOF target for blood pressure measurement (DM003), significantly more patients (p<0.0001) were registered at practices who participated in the NDA (40.7%, CI 40.6 to 40.8) than those who did not participate in the NDA (30.4%, CI 30.3 to 30.5). Similarly for cholesterol (DM004), over two million patients on the diabetes register (70%) met the QOF target and had a cholesterol reading of 5 mmol/L or less in the last 12 months. Of the sample as a whole, 40.4% (CI 40.3 to 40.6) of patients were registered with a practice which took part in the NDA, compared with 30.3% (CI 30.2 to 30.4) of patients who met the target but whose practice did not take part in the NDA (p<0.0001). For HbA1c (DM007) 1.76 million patients on the diabetes register

Table 1 Points achievement threshold limits* for QOF diabetes management indicators

| | Blood pressure (DM003) Threshold range 38%–78% | | Cholesterol (DM004) Threshold range 40%–75% | | HbA1c (DM007) Threshold range 35%–75% | |
|---------------------------------------|---|------|--|------|--|------|
| | n | % | n | % | n | % |
| Practices below threshold lower limit | 20 | 0.3 | 5 | 0.1 | 33 | 0.4 |
| Practices within threshold range | 5796 | 74.7 | 5874 | 75.7 | 7615 | 98.2 |
| Practices above upper threshold limit | 1939 | 25.0 | 1876 | 24.2 | 107 | 1.4 |
| Patients below threshold lower limit | 2758 | 0.1 | 442 | 0.02 | 5262 | 0.2 |
| Patients within threshold range | 2 278 705 | 78.2 | 2 291 654 | 78.7 | 2 887 890 | 99.1 |
| Patients above upper threshold limit | 631 286 | 21.7 | 620 653 | 21.3 | 19 597 | 0.7 |

*Points and payment are rewarded to practices if achievement is above the designated threshold lower limit. HbA1c, hemoglobin A1c; QOF, Quality and Outcomes Framework.

(60%) met the QOF target and had an HbA1c of 59 mmol/mol or less in the preceding 12 months. Of the sample as a whole, 34.5% (CI 34.4 to 34.6) were registered with a practice which took part in the NDA, while 25.8% (CI 25.7 to 25.9) were registered with a practice which did not participate in the audit ($p < 0.0001$).

Relationship between NDA participation and practice demographics

Table 3 illustrates that the demographic characteristics of practices that participated in the NDA differed significantly from those practices that did not participate in the NDA. For example, a significantly smaller proportion of patients in practices who participated in the NDA were aged 65 years or over ($p < 0.0001$) compared with those that did not participate. Practices that participated in the NDA also had significantly larger list sizes ($t(7653) = -9.93$, $p < 0.001$) and a lower prevalence of diabetes mellitus ($p < 0.001$) than practices which did not participate in the NDA. Significant geographic variation in participation also exists ($\chi^2(26) = 676.9$, $p < 0.0001$), while practices that participated in the NDA were significantly more likely to be based in areas of low deprivation compared with practices which did not participate in the NDA ($\chi^2(9) = 36.17$, $p < 0.0001$).

Relationship between practice demographics, NDA participation and QOF achievement

The relationship between NDA participation and QOF achievement for blood pressure, cholesterol and HbA1c measurement was assessed with three logistic regression models. The variables examined in table 3 that were significantly related to NDA participation were included in the model as covariates; these include disease register size, practice size, practice population age, deprivation decile, geographic area, and diabetes prevalence. Logistic regression models (detailed in online supplementary table 1) indicate that participation in the NDA was significantly associated with practice population age, diabetes mellitus prevalence, deprivation decile and geographic area, but also independently and significantly associated with diabetes HbA1c outcome. The results suggest that participation in the NDA was associated with 1% higher odds of patients with diabetes having HbA1c readings of 59 mmol/mol or less in the last 12 months (OR 1.01, CI 1.0 to 1.01, $p = 0.0001$) when controlling for covariates. No significant associations were found for control of blood pressure or cholesterol levels for patients registered with practices that participated in the NDA when adjusting for the covariates disease register size, practice size, practice

Table 2 Patients who met and did not meet the QOF diabetes management targets for blood pressure, cholesterol and HbA1c

| | Blood pressure (DM003) | | | | Cholesterol (DM004) | | | | HbA1c (DM007) | | | |
|---------------------------------------|------------------------|-------|----------------|------|---------------------|-------|----------------|------|---------------|-------|----------------|------|
| | Target met | | Target not met | | Target met | | Target not met | | Target met | | Target not met | |
| | n | % | n | % | n | % | n | % | n | % | n | % |
| Did not participate in NDA (patients) | 885 582 | 30.4* | 357 495 | 12.3 | 882 438 | 30.3* | 360 639 | 12.4 | 750 272 | 25.8* | 492 805 | 16.9 |
| Participated in NDA (patients) | 1 185 475 | 40.7 | 484 196 | 16.6 | 1 178 196 | 40.4 | 491 476 | 16.9 | 1 005 679 | 34.5 | 663 993 | 22.8 |
| Total (patients) | 2 071 057 | 71.1 | 841 692 | 28.9 | 2 060 634 | 70.7 | 852 115 | 29.3 | 1 755 951 | 60.3 | 1 156 798 | 39.7 |

*Significant difference between those who did and did not participate in the NDA and who met the QOF target ($p < 0.0001$). HbA1c, hemoglobin A1c; NDA, National Diabetes Audit; QOF, Quality and Outcomes Framework.

Table 3 Demographic characteristics for practices that did and did not participate in the National Diabetes Audit (NDA)

| | Participated in NDA | Did not participate in NDA | Statistics |
|---|------------------------|----------------------------|-------------------------------|
| Patients in practice aged 65+ years, % (95% CI) | 16.92 (16.89 to 16.95) | 17.29 (17.27 to 17.32) | P<0.0001 |
| Practice list size, mean (SD) | 7774.46 (4513.23) | 6784.73 (4246.99) | t(7,653)=-9.93, p=0.001 |
| Diabetes prevalence, % (95% CI) | 6.31 (6.3 to 6.32) | 6.45 (6.44 to 6.46) | P<0.0001 |
| Deprivation, % (95% CI) | | | $\chi^2(9)=36.17$, p<0.0001 |
| Deprivation decile 1 (most deprived) | 4.91 (4.45 to 5.42) | 4.96 (4.5 to 5.47) | |
| Deprivation decile 2 | 4.94 (4.48 to 5.44) | 4.99 (4.53 to 5.5) | |
| Deprivation decile 3 | 5.42 (4.93 to 5.94) | 4.54 (4.1 to 5.03) | |
| Deprivation decile 4 | 5.56 (5.07 to 6.09) | 4.44 (4 to 4.92) | |
| Deprivation decile 5 | 5.45 (4.97 to 5.98) | 4.58 (4.13 to 5.07) | |
| Deprivation decile 6 | 5.61 (5.12 to 6.14) | 4.45 (4.01 to 4.93) | |
| Deprivation decile 7 | 5.25 (4.77 to 5.77) | 4.73 (4.28 to 5.23) | |
| Deprivation decile 8 | 5.62 (5.13 to 6.16) | 4.44 (4 to 4.92) | |
| Deprivation decile 9 | 5.38 (4.9 to 5.9) | 4.68 (4.23 to 5.17) | |
| Deprivation decile 10 (least deprived) | 6.27 (5.75 to 6.83) | 3.79 (3.39 to 4.24) | |
| Geographic area, % (95% CI) | | | $\chi^2(26)=676.9$, p<0.0001 |
| Arden, Herefordshire and Worcestershire | 1.08 (0.88 to 1.34) | 1.8 (1.53 to 2.13) | |
| Bath, Gloucestershire, Swindon and Wiltshire | 1.79 (1.52 to 2.11) | 0.68 (0.52 to 0.89) | |
| Birmingham and the Black Country | 2.49 (2.16 to 2.86) | 3.26 (2.89 to 3.68) | |
| Bristol, North Somerset, Somerset and South Gloucestershire | 0.7 (0.53 to 0.91) | 1.61 (1.35 to 1.92) | |
| Cheshire, Warrington and Wirral | 0.59 (0.44 to 0.79) | 1.59 (1.33 to 1.89) | |
| Cumbria, Northumberland, and Tyne and Wear | 2.19 (1.89 to 2.54) | 1.62 (1.37 to 1.93) | |
| Derbyshire and Nottinghamshire | 2.26 (1.95 to 2.61) | 1.17 (0.96 to 1.44) | |
| Devon, Cornwall and Isles of Scilly | 1.43 (1.19 to 1.72) | 1.46 (1.21 to 1.75) | |
| Durham, Darlington and Tees | 0.93 (0.74 to 1.17) | 1.21 (0.99 to 1.48) | |
| East Anglia | 2.51 (2.19 to 2.89) | 1.17 (0.96 to 1.44) | |
| Essex | 2.35 (2.03 to 2.71) | 1.08 (0.88 to 1.34) | |
| Greater Manchester | 2.84 (2.49 to 3.23) | 3.48 (3.1 to 3.91) | |
| Hertfordshire and The South Midlands | 2.53 (2.2 to 2.9) | 1.53 (1.28 to 1.83) | |
| Kent and Medway | 0.94 (0.75 to 1.18) | 2.36 (2.04 to 2.72) | |
| Lancashire | 1.38 (1.14 to 1.66) | 1.56 (1.31 to 1.86) | |
| Leicestershire and Lincolnshire | 1.21 (0.99 to 1.48) | 1.91 (1.63 to 2.24) | |
| London | 8.99 (8.37 to 9.64) | 9.05 (8.43 to 9.71) | |
| Merseyside | 1.43 (1.19 to 1.72) | 1.44 (1.2 to 1.73) | |
| North Yorkshire and Humber | 1.84 (1.57 to 2.17) | 1.1 (0.89 to 1.35) | |
| Shropshire and Staffordshire | 1.61 (1.35 to 1.92) | 1.48 (1.24 to 1.78) | |
| South Yorkshire and Bassetlaw | 1.28 (1.05 to 1.55) | 1.48 (1.24 to 1.78) | |
| Surrey and Sussex | 2.94 (2.59 to 3.34) | 1.34 (1.11 to 1.62) | |
| Thames Valley | 2.75 (2.4 to 3.13) | 0.3 (0.2 to 0.44) | |
| Wessex | 2.93 (2.57 to 3.33) | 1.12 (0.91 to 1.38) | |
| West Yorkshire | 3.42 (3.03 to 3.84) | 0.79 (0.61 to 1.01) | |

population age, deprivation decile, geographic area, and diabetes mellitus prevalence.

DISCUSSION

Diabetes is a public health priority requiring adequate management and monitoring at the primary care level to reduce prevalence and prevent complications. Mechanisms to assess progress need, therefore, to be robust and effectively monitored. In April 2017 participation in the NDA became a contractual obligation, and STPs and clinical commissioning groups (CCGs) plan to use the NDA outcomes to help monitor progress locally.

The study aimed to explore GP-related factors which may influence NDA participation and the impact that participation in the NDA may have on diabetes management and patient care. The results indicate that smaller practices from certain areas of the country and those that have a higher proportion of elderly patients, greater diabetes prevalence, and practices with patients from more deprived areas were less likely to participate in the NDA. Evidence from the NDA suggests that a lack of understanding of the benefit of participating, a onerous data submission process, timing of the data submission window, competing priorities and uncertainty around consent, and submitting patient identifiable data may explain why practices with large diabetes and elderly case loads, smaller practices and those from certain areas of the country or from deprived neighborhoods may be less likely to participate in the NDA.²³ It is important that CCGs and STPs are aware of these inequalities when offering support and/or resources (eg, local incentives or the appointment of a local clinical champion) in the future to local practices for diabetes management and monitoring.

It is possible also that additional factors may account for local participation rates. Despite accounting for, and adjusting for, several demographic variables, it was not possible to account for other factors that are not routinely collected. It is possible that these factors could influence NDA participation and diabetes management, which could in turn introduce bias and confound the results. Evidence suggests that other practice-related factors, including practices with a dedicated diabetes recall system, mini-clinic or specialist staff (eg, nurses, dietitians or chiropodists), or those that have fewer patients attending hospital clinics, may have a positive impact on diabetes care and outcome.^{12 13 16} Although these data were not available within the current data set, these factors should be explored locally in the future.

The results also suggest that there are statistical differences in diabetes management outcomes between practices that participated in the NDA and those that did not. HbA1c, but not blood pressure and cholesterol, was independently related to NDA participation when accounting for practice characteristics. This suggests that participation in the NDA may be related to better diabetes outcomes and patient care. However, these

results need to be interpreted with caution as differences are small or marginal and the clinical significance is difficult to determine. It is possible therefore that certain biases may exist which could confound the results. One possible explanation for these results may be the perverse incentive created by the QOF points achievement thresholds. In the clinical areas of the QOF, practices are rewarded with points if their achievement is over a certain threshold. Thresholds for diabetes indicators are in the range of 38%–78% (DM003), 40%–75% (DM004), and 35%–75% (DM007). Practices will generally receive maximum points for an upper threshold and proportionately between those limits.¹⁹ As a consequence, a floor and ceiling effect may occur, because once practices achieve the lower limit of the threshold there may be a lack of further attainment incentive beyond the upper payment thresholds. This can result in little variation in achievement rates across practices and as such may lead to small differences being observed.²⁴ The small, although significant, association between NDA participation and diabetes management may also be explained by the large number of cases in the regression analysis which may have resulted in the model being overpowered. The impact of type 1 versus type 2 diabetes on HbA1c results must also be considered as it is possible that patients with type 1 diabetes have more variation in HbA1c; however, these data were not available for the current study. In addition, only 1 year of data was used in the study. The 2014/2015 data set was selected as it was the first year that a voluntary opt-in participation process was used. This meant that the process was more similar to the contractual obligations now adopted and ensured equal grouping and few missing data which may otherwise have biased the analysis. Further investigation should replicate the study with data from the first year of compulsory participation once this becomes available. Lastly, caution must also be used when interpreting these findings, particularly when using the NDA to help monitor local progress and commissioning as there are subtle differences in NDA and QOF metadata. For example, there are differences in HbA1c parameters used, and differences in the timing and inclusion of patients in the NDA and QOF data sets; NDA covers all patients with diabetes over a 15-month period, while QOF covers patients aged 17 years and older over a 12-month period. While overall there is a significant relationship between the NDA and QOF outcome data at the practice level, these subtle differences should be considered when interpreting the results of these analyses.

Despite the cautious interpretation of the relationship between NDA participation and diabetes outcome using HbA1c as a marker, it is important to consider the generalizability of the study's findings to participation in other mandatory and non-mandatory activities/clinical audits and the wider impact on patient outcome. It may also be important to consider whether patients should be made aware of, or encouraged to inquire, about practice participation in the audit to increase practice accountability

given the impact that participation may have on diabetes care offered.

In conclusion, the results indicate that variation in NDA participation exists. Despite the fact that submission to the audit is now a contractual requirement, it may be possible that practices with certain identifiable characteristics may struggle to collect and submit sufficient data of an adequate quality to the audit. It is suggested therefore that some GPs may need additional support and resources to address these inequalities and to aid data collection and submission. In addition, although the markers of diabetes management used in the NDA are well established, their ability to discriminate between areas at a population level, in order for STPs and other government organizations to measure progress with care, is less certain. Given the changes to contractual obligations and the importance of effective diabetes management to population health, further evaluation is required.

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Contributors HK conceived the study and this was developed further by CEW. Statistical design was led by CEW and SY, who extracted and analyzed the data with AW. All authors contributed to the interpretation of the results. CEW led the writing of the manuscript, to which all authors reviewed and contributed. CEW is the guarantor for this work. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and accuracy of the data analysis.

Competing interests None declared.

Patient consent Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement All data sets used aggregated, anonymized data and did not require patient consent. The study used routinely collected data that are openly available in the public domain. The statistical code and analysis is available on request from the corresponding author (caroline.wright@phe.gov.uk).

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