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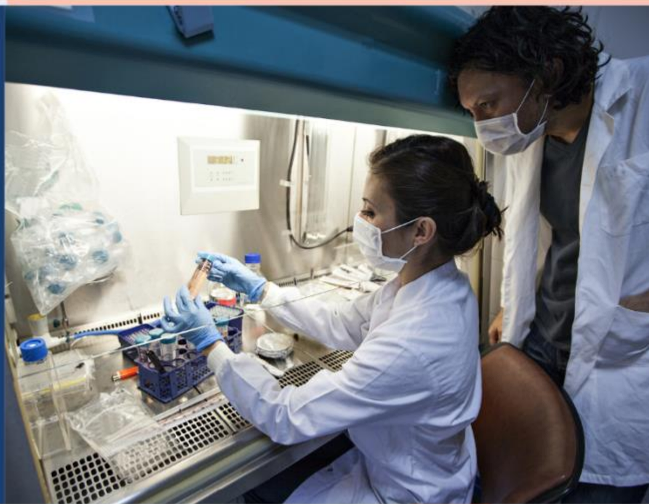
Estimating the ‘Rule of Halves’ for Greater Manchester



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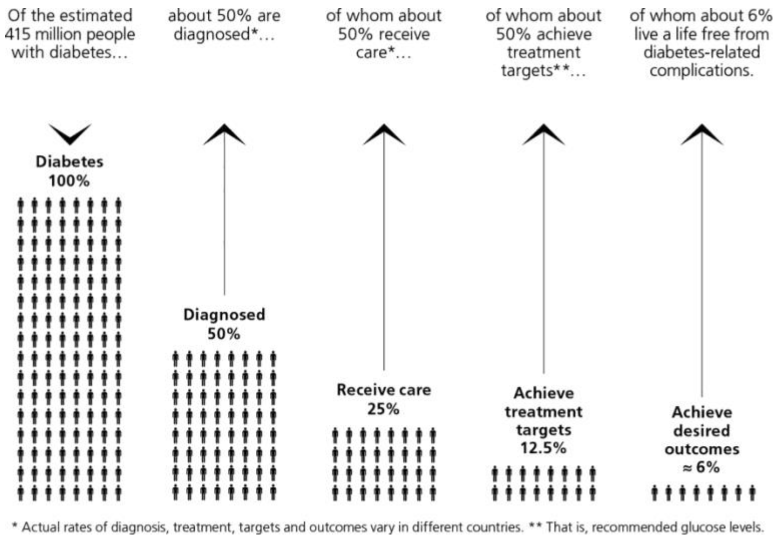
1.0 Background

There are 55.9 million people in the United Kingdom (UK) living in urban areas, 83.6% of the population (1). Since 1960, the urban population of the UK has grown by 14.8 million and the rural population has reduced by around 370,000 (1). These national trends mirror wider global changes (2). Demographic shifts towards urban areas have consequences that include changes in residents' occupational profiles and health behaviours, and for non-communicable chronic illnesses including diabetes (3,4).

Previous studies have shown that more than 70% of people with diabetes live in urban areas (5). Orthodox risk-factors such as body mass index (BMI), age, diet, family diabetes history and education do not fully explain differences in the diabetes risk of different economic groups of urban-residing individuals (6). The Cities Changing Diabetes (CCD) programme was established in 2014 to further understanding of the burden of diabetes and its social and cultural determinants across a range of cities globally (4).

One element of CCD is to describe the pattern of diabetes in terms of: prevalence; diagnosis; receipt of quality care; achievement of treatment targets; and diabetes health outcomes (Figure 1.1).

Figure 1.1: conceptual diagram of the ROH



The 'rule of halves' (ROH) originates from the observation that numbers have been observed to roughly halve at each level from prevalence to outcomes (7), suggesting gaps in appropriate identification, management and treatment of diabetes along the care pathway. In practice, the ROH might represent a broad 'rule of thumb'.

Whilst 'halving' was found to apply for the British NHS in the 1980s for chronic illnesses including diabetes, hypertension and asthma (8), more recent evidence suggests that the ROH varies between countries for diabetes. Studies from low and middle-income countries demonstrate this divergence. For example, estimates from India suggests a rule of 'two-thirds' (i.e. a better performance than halving across levels) (9), whereas evidence from Peru comparing ROH patterns in urban and rural settings suggests considerably poorer performance than halving on both care quality and treatment targets (10). Applications of the ROH from high-income settings are equally inconsistent: evidence from Denmark outlined performance far in excess of 'halving' – in particular for diagnosing diabetes and providing treatment (11). Whereas evidence from Australia indicated that the ROH does in fact generally apply for diabetes care and management (12).

Recent studies have updated historical evidence on the detailed pattern of the ROH for other chronic illnesses such as hypertension and osteoarthritis in England (13–15). However, there are no recent efforts to update historical evidence on the ROH for cities in England despite innovations in diabetes care and prevention over recent decades (16–18). This study seeks to update the existing evidence by populating the ROH for Greater Manchester in the North West of England, one of the three largest cities in England whose population was estimated to be 2.8 million in 2016.

2.0 Data

The ROH requires data on: diabetes prevalence rates and the estimated size of the population; the number of individuals with a recorded diagnosis of diabetes in administrative records; the number of individuals receiving appropriate diabetes care quality; and the number of individuals achieving appropriate diabetes treatment targets.

2.1 Diabetes prevalence

We obtained estimated prevalence of diabetes using individual-level data at wave 7 of the UK Household Longitudinal Survey (UKHLS) (covering 2015-2017) (19). The survey started in 2009, initially comprising 40,000 households across the UK. The survey captures detailed information on mental and physical health in addition to a range of other topics including on urbanity/rurality of respondents' households. It contains large sample of individuals and its sampling methodology allows for examination of a nationally representative group of individuals. We used data for GM only to derive an estimate of the mean annual prevalence of diabetes in GM for the period 2015-17. We also retained data on three comparable cities (Liverpool, Sheffield and Hull) in the north of England in order to be able to compare to GM estimates.

2.2 Total population estimates and rural/urban locations

We used estimates of population size at Clinical Commissioning Group (CCG) level by single year of age and sex for England in mid-2016 from the Office for National Statistics (ONS) (20). CCGs are responsible for the commissioning of health services for a defined regional area in England. We combined CCG population size data with ONS geographic data to capture urban and rural spread, to ensure that GM maps to urban areas only (21). Additional detail on these data is provided in the appendix.

2.3 Diabetes registrations, care quality and treatment target achievement

We obtained practice-level data for England in 2016-17 from the National Diabetes Audit (NDA) (22). NDA measures the effectiveness of diabetes care against National Institute for Health and Care Excellence (NICE) Clinical Guidelines and Quality Standards in England and Wales (23). These data contain information on the number of individuals: with a diabetes diagnosis recorded in administrative records; receiving appropriate care quality; and achieving appropriate treatment targets.

Care quality and treatment target achievement are captured in the NDA via indicators of eight care processes (which should be provided in line with clinical guidelines), and indicators of three treatment targets (that are appropriate for people with diabetes) (Table 2.1). There are then two summary indicators of the numbers of patients achieving all eight care processes and three treatment targets respectively. We use these latter summary indicators to measure care quality and treatment target achievement in this study.

2.4 Complications associated with diabetes

We used CCG-level data for England on complications associated with diabetes derived from the CCG Outcome Indicator Set (24). These data measure:

> "The number of people with diabetes identified by the NDA who were alive at the start of the follow-up period who have a HES record of NDA complications during the follow-up period, using ICD-10 primary or secondary diagnosis codes or primary and secondary OPCS codes."

These are summarised in Table 2.2.

Table 2.1: Appropriate Care Processes and Treatment Targets recorded in the NDA

NICE recommended Annual Care Processes	
Process	Detail
HbA1c	blood test for glucose control
Blood Pressure	measurement for cardiovascular risk
Serum Cholesterol	blood test for cardiovascular risk
Serum Creatinine	blood test for kidney function
Urine Albumin/Creatinine Ratio	urine test for early kidney disease
Foot Risk Surveillance	foot examination for foot ulcer risk
Body Mass Index	measurement for diabetes management
Smoking History	question for cardiovascular risk
NICE recommended Treatment Targets	
Target	Rationale
HbA1c < 58 mmol/mol	target HbA1c reduces the risk of all diabetic complications
Blood pressure < 140/80	target blood pressure reduces the risk of cardiovascular complications and reduces the progression of eye disease and kidney disease
Cholesterol < 5mmol/L	target cholesterol reduces the risk of cardiovascular complications

Table 2.2: Diagnosis and procedure code types used to identify hospital admissions for diabetes complications

CCG OIS Indicator 2.8: types of ICD-10 (diagnosis) used by the NDA	
ICD Code Prefix	Definition
E1x.x	Codes for Diabetic Ketoacidosis (DKA)
I20.x	Codes for Angina
I21.x / I22.x	Codes for Myocardial Infarction
I50.x	Codes for Heart Failure
I6x.x	Codes for Stroke
N18.0 / Z49.x / Z99.2	Codes for Renal Replacement Therapy (RRT)
CCG OIS Indicator 2.8: types of OPCS4 (procedure) used by the NDA	
OPCS Code Prefix	Definition
M01.x / X40.x	Codes for RRT
C82.x	Codes for Retinopathy treatments
X09.x	Codes for major Amputation
X1x.x	Codes for minor Amputation

We retained data on this indicator for CCGs for GM and comparison cities for the year 2017-18, which denotes the appropriate follow-up period year for this indicator for the NDA population captured in the 2016-17 data on diagnoses in care records, care quality and treatment targets.

3.0 Methods

3.1 Populating the levels of the ROH

Estimating mean diabetes prevalence

We combined data from wave 7 (2015-17) of the UKHLS on participants' self-reports of health conditions with information from a nurse visit assessment in waves 2 and 3 (2010-12) including measurement of glycated haemoglobin (HbA1c). We used this information to create an indicator of whether a participant had diabetes or not at wave 7 to align with the time period covered by the other data sources in this study.

We then used the UKHLS measure of area of residence to identify respondents located in GM and comparison cities. We estimated prevalence of diabetes in these two groups at wave 7 (2015-17) including corresponding confidence intervals, applying appropriate longitudinal sample weights (27).

Estimating total diabetes prevalence registrations, care quality, treatment target achievement and complications

To estimate total population prevalence, we aggregated mid-2016 population estimates by age and sex to total figures for GM and comparison cities and applied mean prevalence estimates.

We aggregated 2016-17 data from the NDA at practice-level to aggregated totals for GM and comparison cities. These data provide the total number of: diabetes registrations; patients receiving all eight care processes; and patients achieving all three treatment targets. Data for 2017-18 on diabetes complications were also aggregated – from CCG-level to the appropriate totals for GM and comparison cities.

The aggregate figures for the ROH are summarised in tables and figures.

3.2 Comparison of prevalence estimates with diagnoses in care records for population sub-groups in GM

We compared how prevalence and diagnoses in care records are distributed across population sub-groups for GM to understand the representation of the prevalent diabetic population at GM general practices, in order to highlight potential issues around access to diabetes care in specific population groups.

3.3 Analyses of prevalence

We explored the odds of having diabetes by age, sex and deprivation and ethnic origin for GM respondents to waves 1- 7 of the UKHLS (covering 2009 to 2017), and then repeated this analysis for wave 7 (2015-17) only to align with the time period for the aggregate ROH.

Models were estimated using logistic regression in Stata IC 14.0 using longitudinal sample weights. Analyses for GM respondents in waves 1-7 included fixed effects for calendar time (wave indicators).

3.4 Analyses of care quality

We examined how the percentage of registered people with diabetes receiving all eight care processes (Table 2.1) according to known characteristics of practices' registered diabetic populations in GM and comparison cities using descriptive analyses.

The practice characteristics assessed were:

- age structure of the registered diabetic population (percentages of practice registered diabetic patients in the following groups - under 40; 40-64; 65-79; 80 and over);
- sex of the registered diabetic population (percentage of practice registered diabetic patients who were female);

- deprivation level (percentages of practice registered diabetic patients from the two most deprived IMD deprivation quintiles);
- ethnic group (percentage practice registered diabetic patients who were: white; minority ethnic origin; unknown ethnicity);
- the size of the registered diabetic population (binary indicators for whether a practice's registered diabetic population was: <250; 250-499; 500-749; >750).

We then used regression analyses to examine whether/how the percentage of registered people with diabetes receiving all eight care processes (appropriate care) varied significantly according to the above practice-level characteristics.

Models were estimated using linear regression in Stata IC 14.0 for the period 2015-16 to 2018-19, and analyses were repeated for 2016-17 only to align with the time period captured in the aggregate ROH. We weighted analyses by the size of practices' registered diabetic populations, included fixed effects for clinical commissioning groups (CCGs), and included year indicators for analyses of the period 2015-16 to 2018-19.

3.5 Analyses of treatment targets

We examined how the percentage of registered people with diabetes achieving all three treatment targets (Table 2.1) according to known characteristics of practices' registered diabetic populations in GM and comparison cities using descriptive analyses. The same practice characteristics as defined above were used in descriptive analyses.

We again used regression analyses to examine how the percentage of registered people with diabetes achieving all three treatment targets varied significantly according to the above practice-level characteristics in addition to the influence of the percentage of patients receiving appropriate care.

We performed linear regression for 2015-16 to 2018-19, and analyses were repeated for 2016-17. We weighted analyses by the size of practices' registered diabetic populations, included fixed effects for clinical commissioning groups (CCGs), and included year indicators for analyses of the period 2015-16 to 2018-19.

4.0 Results

4.1 Estimates of the ROH

Estimates of mean diabetes prevalence for GM respondents to the UKHLS

Diabetes prevalence in GM was estimated to be 8.58% (95% CI [6.51%; 10.6%]) for 2015-17, compared with 7.04% (95% CI [4.28%; 9.79%]) for comparison cities (Table 4.1).

Table 4.1 Estimates of mean diabetes prevalence for GM (2015-17) derived from UKHLS

	N	Mean	95% CI
GM	1,812	8.58%	[6.51%; 10.6%]
Liverpool, Sheffield & Hull	719	7.04%	[4.28%; 9.79%]

Notes: estimated from UKHLS Wave 7 (2015-2017), longitudinal sample weights applied

Applying this prevalence value to a GM population estimate of 2.87 million (mid-2016), we would expect 246,466 people to have diabetes for 2016-17.

Estimates of the ROH for GM

In total, 156,179 people were diagnosed with diabetes in primary care in GM for 2016-17 (t 63% of the estimated population with diabetes) (Figure 4.1; Table 4.2). Of diagnosed patients, 51.72% (80,776) received all eight of the appropriate care processes in primary care. Relative to the population patients receiving appropriate care, 72.6% of diagnosed diabetics achieved HbA1c treatment targets. Finally, 91.62% of those with a diabetes diagnosis in primary care did not have a diabetes complication leading to hospital admission in the appropriate follow-up year (2017-18).

Table 4.2 Populated levels of the ROH of GM and comparison cities

	GM			Comparison cities		
	Estimated total population = 2.87 million			Estimated total population = 1.32 million		
	Total	*Estimated prevalence [95% CI]*		*Total*	*Estimated prevalence [95% CI]*	
Survey data from UKHLS (2015-17) and population data from ONS (mid-2016)						
Diabetes prevalence	246,466	8.58% [6.51%; 10.64%]		93,047	7.04% [4.29%; 9.79%]	
Administrative data from NDA (2016-17) and CCG OIS (2017-18)						
	Total	*% of previous level*	*% of registered patients*	*Total*	*% of previous level*	*% of registered patients*
Registrations	156,173	63.36%	100.00%	61,538	66.14%	100.00%
Appropriate Care Quality	80,775	51.72%	51.72%	36,156	58.75%	58.75%
Achieve Treatment Targets	58,646	72.60%	37.55%	22,491	62.21%	36.55%
Without complications	143,083	N/A*	91.62%	56,010	N/A*	91.02%

Notes: diabetes prevalence estimated using UKHLS data for Wave 7 (2015-17); previous level refers to row above (as denominator); *data on complications stratified by those achieving and not achieving treatment targets unavailable

Comparison cities were estimated to have higher rates of diagnosis in primary care than GM (66.14% vs. 63.37%), and higher rates of provision of appropriate care (58.76%) (Figure 4.2). However, GM has higher rates of achievement of HbA1c targets amongst patients receiving appropriate care (72.60% vs. 62.21%), and fractionally more GM patients with a record of diabetes were not admitted to hospital in the follow-up year for complications of diabetes (91.62% vs. 91.02%).

Figure 4.1: Estimated ROH for GM

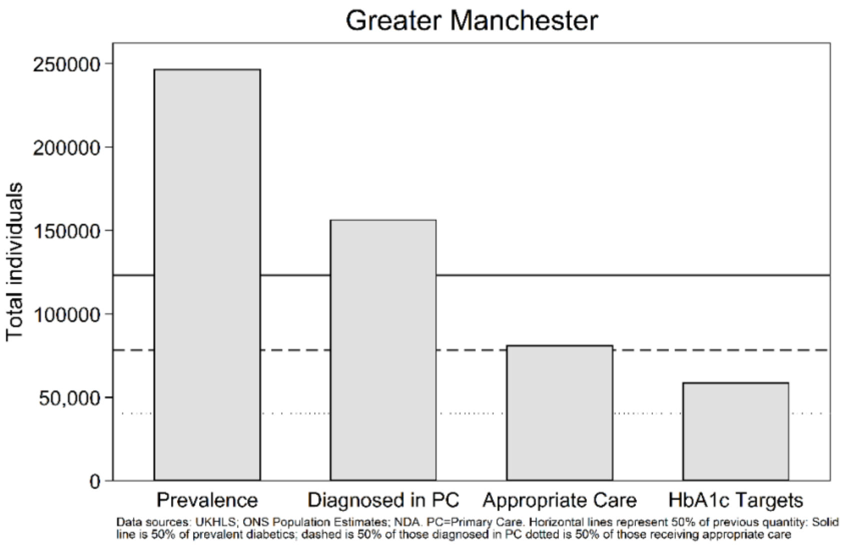
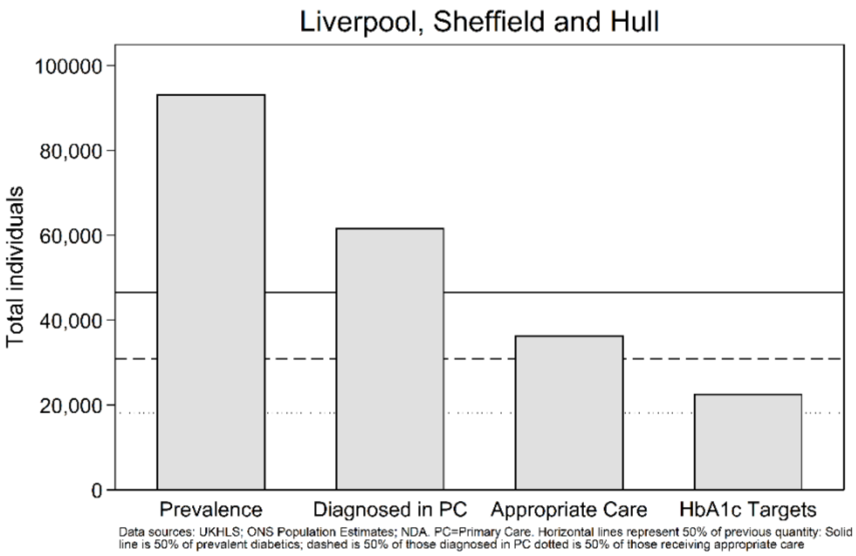


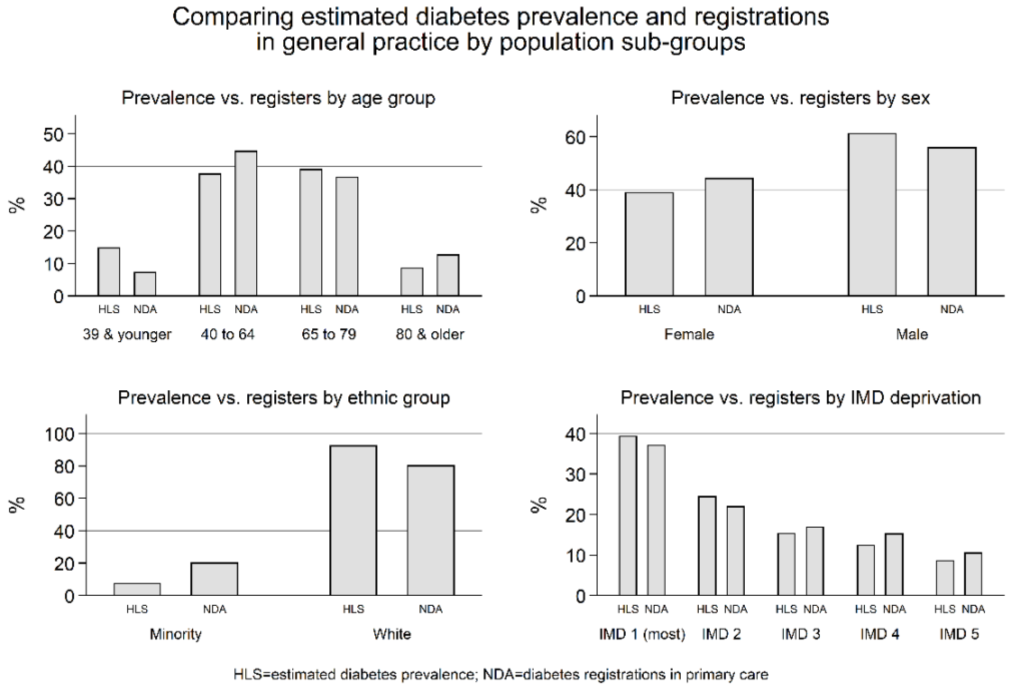
Figure 4.2 Estimated ROH for comparison cities



4.2 Assessing how the prevalent population are represented in primary care registers

For GM, comparisons between estimated prevalence and known diagnosis in primary care indicate that adults under 40, people of white ethnic origin, males, and people from the most deprived neighbourhoods are relatively underdiagnosed in primary care (Figure 4.3).

Figure 4.3 Representation of population sub-groups in survey (prevalence) vs. registration (diagnoses in care) data for GM



4.3 Regression analyses of diabetes prevalence in GM

In GM, compared with those aged 40 and under: people aged 40-64 have odds of diabetes that are 3.68 times greater (95% CI [2.67; 5.06]); those aged 65-79 have odds 10.93 greater (95% CI [7.87; 15.18]); and those aged 80 and over have odds 9.05 times greater (Table 4.3).

Women have diabetes odds that are 0.55 times those of men (95% CI [0.46; 0.66]), and those resident in the most deprived 20% of areas have odds 1.45 times greater than those in the middle 20% by deprivation (95% CI [1.13; 1.87]). This compares with those in the least deprived 20% being 0.56 times as likely to have diabetes (95% CI [0.39; 0.80]).

Table 4.3: Analyses of diabetes prevalence for GM (Waves 1-7 of the UKHLS)

N=8,767	Odds Ratio	P>z	[95% CI]	
Under 40	(reference group)			
Aged 40 to 64	3.68	0.00	2.67	5.06
Aged 65 to 79	10.93	0.00	7.87	15.18
Aged 80 and over	9.05	0.00	5.77	14.21
Female	0.55	0.00	0.46	0.66
White	(reference group)			
Minority	1.00	0.98	0.76	1.32
Unknown	1.98	0.36	0.45	8.67
1 (most deprived)	1.45	0.00	1.13	1.87
2	1.07	0.65	0.80	1.43
3 IMD Groups	(reference group)			
4	0.63	0.00	0.46	0.86
5 (least deprived)	0.56	0.00	0.39	0.80

Notes: Model estimated using logistic regression in Stata; longitudinal weights applied; pseudo r-squared=0.11

Analyses restricted to wave 7 of the UKHLS (covering 2015-17 only) estimated relationships that were qualitatively equivalent to those estimated for waves 1-7 (Table 4.4).

Table 4.3: Analyses of diabetes prevalence for GM (Wave 7 of the UKHLS only)

N=779	Odds Ratio	P>z	[95% CI]	
Under 40	(reference group)			
Aged 40 to 64	4.21	0.01	1.47	12.07
Aged 65 to 79	10.45	0.00	3.55	30.70
Aged 80 and over	9.96	0.00	2.49	39.83
Female	0.68	0.15	0.39	1.16
White	(reference group)			
Minority	0.75	0.52	0.32	1.78
1 (most deprived)	2.59	0.02	1.13	5.95
2	1.59	0.28	0.68	3.69
3 IMD Groups	(reference group)			
4	0.85	0.74	0.33	2.22
5 (least deprived)	0.43	0.19	0.12	1.52
Constant	0.02	0.00	0.01	0.07

Notes: Model estimated using logistic regression in Stata; longitudinal weights applied; pseudo r-squared=0.12

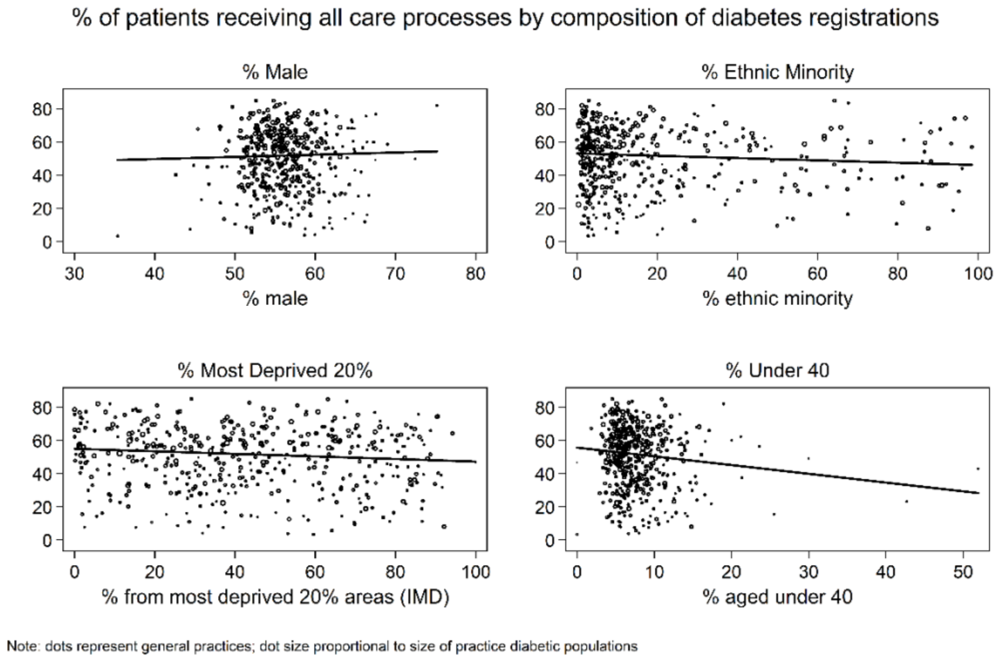
4.4 Analyses of care quality

Descriptive analyses

Figure 4.4 illustrates the relationship between the % of patients receiving all care processes and specific dimensions of the profile of practices' registered diabetes populations. Marker size in the scatter plot is proportional to the size of the registered diabetes populations for individual practices.

Practices with a higher proportion of younger patients had a lower rate of patients receiving appropriate care (Figure 4.4). The rate of patients receiving appropriate care also decreases in practices with more patients from ethnic minority groups and from the most deprived areas (Figure 4.4).

Figure 4.4: % of GM patients receiving appropriate care vs. % of diabetes registrations in population subgroups



Similar gradients were observed in terms of care quality in the comparison cities – except for across deprivation where there is a slight increase in the rate of patients receiving appropriate care in practices with more patients residing in the most deprived neighbourhoods (Appendix Figure 7.1).

Regression analyses

In GM, practices with a higher proportion of patients with a record of diabetes from the most deprived 40% of neighbourhoods had lower rates of patients receiving all eight care processes (Table 4.4): for each additional 10% of patients from these neighbourhoods, 0.76% fewer patients received appropriate care (95% CI [-1.30; -0.22]).

Practices with relatively fewer diagnosed diabetics had lower rates of patients receiving appropriate care: compared with practices with between 250 and 499 patients with a diagnosis of diabetes, practices with fewer than 250 patients with a record of diabetes had 6.491% fewer patients receiving appropriate care (95% CI [-8.928; -4.054]).

Table 4.4: regression analysis of % of receiving appropriate quality diabetes care vs. characteristics of practices' diabetic populations (2015-16 to 2018-19)

N=1,745, Adj. R-squared: 0.184	Coefficient	P>t	[95% CI]	
% under 40	0.076	0.665	-0.268	0.420
% 65-79	0.129	0.288	-0.109	0.366
% 80 +	-0.138	0.451	-0.496	0.221
% Female	-0.161	0.190	-0.402	0.080
% Minority	-0.032	0.292	-0.092	0.028
% Unknown	-0.011	0.662	-0.061	0.039
% from most deprived 40%	-0.076	0.006	-0.130	-0.022
Registered diabetics (< 250) = 1	-6.491	0.000	-8.928	-4.054
Registered diabetes (250-499)=1	**(reference)**			
Registered diabetics (500-749) = 1	3.486	0.002	1.266	5.706
Registered diabetics (750 +) = 1	1.676	0.332	-1.715	5.067
Year = 2015-16	**(reference)**			
Year = 2016-17	-2.137	0.113	-4.777	0.504
Year = 2017-18	5.074	0.000	2.513	7.634
Year = 2018-19	8.212	0.000	5.654	10.770
Constant	61.986	0.000	44.970	79.002

Notes: Model estimated using weighted linear regression in Stata; fixed effects for CCGs included but not shown; models estimated including robust standard errors; regression units are general practices

Conversely, practices with more registered patients with a recorded diagnosis of diabetes had higher rates of patients receiving all eight care processes: compared with practices with between 250 and 499 patients with a diagnosis of diabetes, practices with between 500 and 749 patients with a record of diabetes had 3.486% more patients receiving appropriate care (95% CI [-8.928; -4.054]).

Practice performance in terms of providing appropriate care quality improved across in the latter two years of the time period considered: relative to 2015-16; 5.074% more registered diabetic patients received all eight care processes in 2017-18 (95% CI [2.513; 7.634]); and 8.212% more in 2018-19 (95% CI [5.654; 10.770]).

Results for 2016-17 only were qualitatively similar (Appendix Table 7.1).

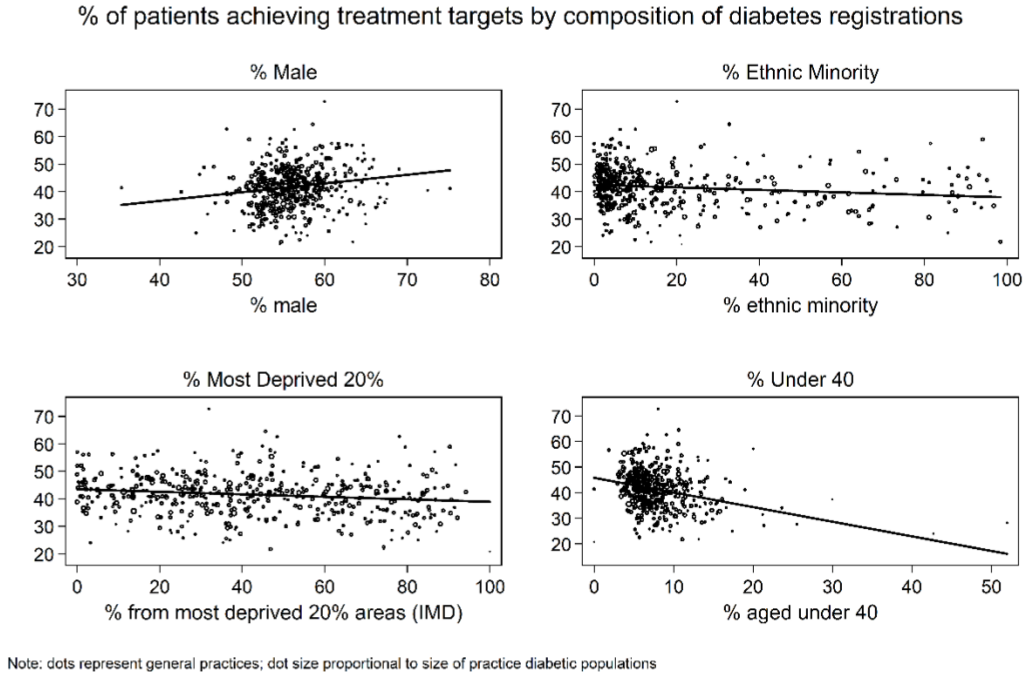
4.5 Analyses of treatment targets

Descriptive analyses

Figure 4.5 illustrates the relationship between the % of patients achieving all three treatment targets and specific dimensions of the profile of practices' registered diabetes populations. Marker size in the scatter plot is proportional to the size of the registered diabetes populations for individual practices.

Practices with a higher proportion of registered diabetic patients who are male had on average higher rates of patients achieving treatment targets (Figure 4.5). Practices with a higher proportion of diabetes patients from ethnic minorities male had on average lower rates of patients achieving treatment targets, and the practices with higher proportions of patients under 40 had substantially worse performance in terms of patients achieving all three treatment targets. The same gradients were observed for comparison cities (Appendix Figure 7.2).

Figure 4.5: % of GM patients achieving treatment targets vs. % of diabetes registrations in population subgroups



Regression analyses

In GM, practices with a higher proportion of diabetic patients aged under 40 had lower rates of patients achieving treatment targets (Table 4.5): for each additional 10% of patients aged under 40, 2.83% fewer patients achieved these targets (95% CI [-4.17; -1.49]). Whereas practices with a higher proportion of patients aged 65-79 had higher rates of patients achieving treatment targets: for each additional 10% of patients aged 65-79, 1.74% more patients achieved these targets (95% CI [0.81; 2.68]).

Practices with a higher proportion of female diabetic patients had lower rates of treatment target achievement: for each additional 10% of female patients, 1.94% fewer patients achieved these targets (95% CI [-2.87; -1.02]).

Practices with relatively fewer diagnosed diabetics had lower rates of patients receiving appropriate care: compared with practices with between 250 and 499 patients with a diagnosis of diabetes, practices with fewer than 250 patients with a record of diabetes had 6.491% fewer patients receiving appropriate care (95% CI [-8.928; -4.054]).

Table 4.5: regression analysis of % achieving treatment targets vs. characteristics of practices' diabetic populations (2015-16 to 2018-19)

N=1,745, Adj. R-squared: 0.095	Coefficient	P>t	[95% CI]	
% under 40	-0.283	0.000	-0.417	-0.149
% 65-79	0.174	0.000	0.081	0.268
% 80 +	0.035	0.545	-0.078	0.147
% Female	-0.194	0.000	-0.287	-0.102
% Minority	0.044	0.000	0.022	0.067
% Unknown	0.003	0.692	-0.014	0.020
% from most deprived 40%	0.002	0.880	-0.018	0.021
Registered diabetics (< 250) = 1	0.641	0.175	-0.286	1.568
Registered diabetics (500-749) = 1	0.142	0.735	-0.682	0.966
Registered diabetics (750 +) = 1	-0.033	0.955	-1.166	1.100
Year = 2015-16	**(reference)**			
Year = 2016-17	0.980	0.051	-0.003	1.963
Year = 2017-18	1.276	0.009	0.316	2.237
Year = 2018-19	1.812	0.000	0.880	2.744
Constant	66.634	0.000	36.011	97.258

Notes: Model estimated using weighted linear regression in Stata; fixed effects for CCGs included but not shown; models estimated including robust standard errors; regression units are general practices

Practices with a higher proportion of diabetic patients from ethnic minorities had higher rates of treatment target achievement: for each additional 10% of patients from these groups, 0.44% more patients achieved these targets (95% CI [0.22; 0.67]).

Practice performance in terms of treatment target improved across the period from 2015-16 to 2018-19: on average, 1.812% more patients achieved these targets in 2018-19 compared with 2015-16.

Table 4.6: regression analysis of % achieving treatment targets vs. characteristics of practices' diabetic populations - including care quality as an explanatory variable (2015-16 to 2018-19)

N=1,745, Adj. r-squared: 0.170	Coefficient	P>t	[95% CI]	
% under 40	-0.291	0.000	-0.420	-0.163
% 65-79	0.160	0.001	0.070	0.250
% 80 +	0.050	0.318	-0.048	0.148
% Female	-0.177	0.000	-0.264	-0.089
% Minority	0.048	0.000	0.026	0.070
% Unknown	0.005	0.583	-0.012	0.021
% from most deprived 40%	0.010	0.321	-0.010	0.030
Registered diabetics (< 250) = 1	1.359	0.003	0.477	2.242
Registered diabetics (500-749) = 1	-0.244	0.547	-1.038	0.551
Registered diabetics (750 +) = 1	-0.218	0.702	-1.337	0.900
Year = 2015-16	**(reference)**			
Year = 2016-17	1.217	0.011	0.274	2.160
Year = 2017-18	0.715	0.131	-0.213	1.642
Year = 2018-19	0.903	0.053	-0.012	1.817
% receiving appropriate care	0.111	0.000	0.092	0.129
Constant	33.103	0.000	26.676	39.530

Notes: Model estimated using weighted linear regression in Stata; fixed effects for CCGs included but not shown; models estimated including robust standard errors; regression units are general practices

Table 4.6 repeats the analyses from Table 4.5, but includes the percentage of diabetic patients at individual practices receiving appropriate care as an explanatory variable.

The results are largely qualitatively similar. Practices with a higher proportion of diabetic patients receiving appropriate care had higher rates of treatment target achievement: for each additional 10% of patients receiving all eight care processes: 1.11% more patients achieved these targets (95% CI [0.92; 1.29]).

However, the estimated improvement in treatment target achievement in later years seen in Table 4.5 is no longer significantly different than in the reference year 2015-16. This may indicate the influence of substantial improvements in providing appropriate care quality in later years (Table 4.4) in driving improved treatment target achievement in these years.

Results for 2016-17 were qualitatively equivalent (Appendix Tables 7.2 and 7.3).

5.0 Discussion

5.1 Summary of key findings

Whilst the ROH is a useful heuristic, the 'halving' interpretation does not apply for GM. GM performs considerably better than 'half' in terms of primary care-recorded diagnosis of diabetes (as a proportion of estimated diabetes prevalence in the population). Just over half of those registered receive the appropriate quality of care, and less than 40% of patients with a diagnosis record of diabetes achieve appropriate treatment targets. We compared results for relatively comparable cities in the North of England, and the pattern of results was largely similar – though GM performed worse in terms of providing the appropriate care to those registered.

Analyses for subgroups in GM estimate that adults under 40 and men are relatively underrepresented in care records. Those with recorded white ethnicity are also estimated to be underrepresented, and those from the most deprived neighbourhood are also estimated to be underrepresented.

Practices with more diabetic patients from the most deprived neighbourhoods had lower rates of patients receiving the appropriate care quality, and practices with a relatively small number of diabetes patients also had lower rates of patients receiving appropriate care. Practices in GM improved substantially in terms of providing appropriate care quality to diabetes patients over the period from 2015-16 to 2018-19.

Practices serving a higher proportion of young diabetes patients (aged under 40) performed worse in terms of the percentages achieving diabetes treatment targets, as did those with a higher proportion of female patients. Practices' improvements in later years as regards providing appropriate care quality appeared to increase treatment target achievement in those later years.

5.2 Limitations

We used individual-level survey data from the UKHLS to estimate population prevalence of diabetes for GM and applied these estimates to population estimates from the ONS for GM. The strength of this approach lies in using non-administrative data to obtain an estimate of prevalence independent of access to care – and also in accurately describing the characteristics of the population with diabetes. However, such estimates have corresponding uncertainty.

The administrative data used to populate diagnoses, care quality, treatment targets and diabetes outcome (complications leading to hospital admission) were at an aggregate-level (general practice level), and were not stratified according to population characteristics or other domains of interest. This meant that, for the latter pillars of the ROH, we could not use the ideal quantities in the denominator: for example, we did not have data on treatment target achievement split by those receiving and not receiving the appropriate care. We also did not have data on diabetes related outcomes according to those achieving and not achieving treatment targets. This limitation inherent in the data used does not permit full comparison across the levels for an ideal illustration of the ROH, and should be considered when interpreting the findings.

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7.0 Appendix

Figure 7.1: % of patients in comparison cities receiving appropriate care vs. % of diabetes registrations in population subgroups

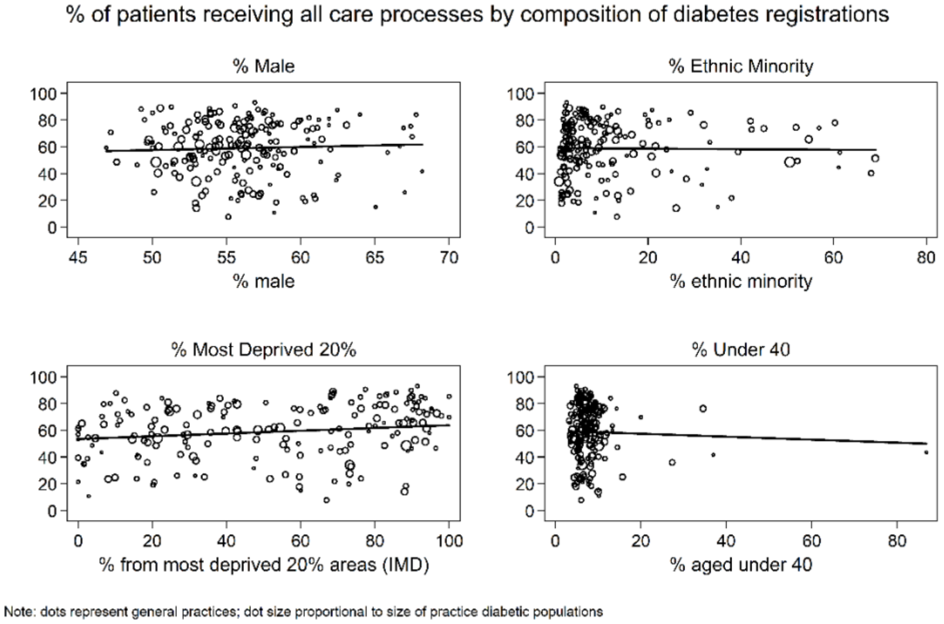
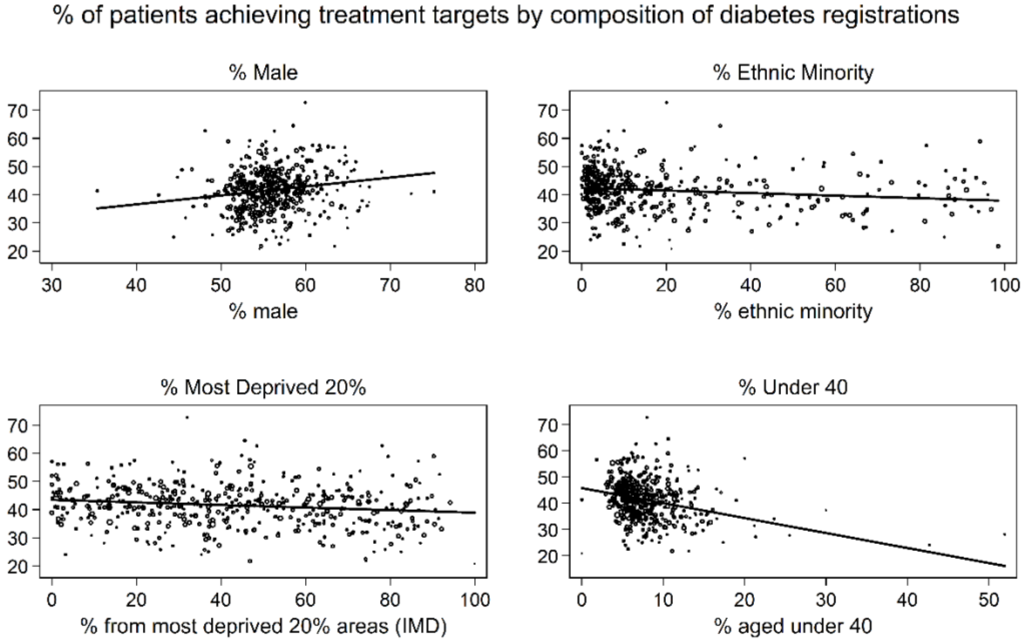


Table 7.1: regression analysis of % of receiving appropriate quality diabetes care vs. characteristics of practices' diabetic populations (2016-17 only)

N=438; Adj. R-squared: 0.131	Coefficient	P>t	[95% CI]	
% under 40	-0.116	0.744	-0.817	0.584
% 65-79	0.059	0.796	-0.388	0.506
% 80 +	-0.197	0.598	-0.933	0.538
% Female	-0.170	0.494	-0.660	0.319
% Minority	-0.085	0.179	-0.210	0.039
% Unknown	-0.015	0.777	-0.120	0.089
% from most deprived 40%	-0.091	0.104	-0.201	0.019
Registered diabetics (< 250) = 1	-6.251	0.017	-11.382	-1.121
Registered diabetics (500-749) = 1	4.593	0.060	-0.203	9.389
Registered diabetics (750 +) = 1	1.151	0.768	-6.519	8.821
Constant	66.634	0.000	36.011	97.258

Notes: Model estimated using weighted linear regression in Stata; fixed effects for CCGs included but not shown; models estimated including robust standard errors; regression units are general practices

Figure 7.2: % of patients from comparison cities achieving treatment targets according to % of registrations in subgroups



Note: dots represent general practices; dot size proportional to size of practice diabetic populations

Table 7.2: regression analysis of % achieving treatment targets vs. characteristics of practices' diabetic populations (2016-17 only)

N=438; Adj. R-squared: 0.113	Coefficient	P>t	[95% CI]	
% under 40	-0.378	0.014	-0.678	-0.077
% 65-79	0.137	0.159	-0.054	0.329
% 80 +	0.185	0.139	-0.060	0.430
% Female	-0.224	0.024	-0.419	-0.030
% Minority	0.035	0.145	-0.012	0.081
% Unknown	0.011	0.527	-0.023	0.044
% from most deprived 40%	0.011	0.591	-0.029	0.051
Registered diabetics (< 250) = 1	0.494	0.627	-1.504	2.493
Registered diabetics (500-749) = 1	-0.265	0.761	-1.976	1.446
Registered diabetics (750 +) = 1	0.252	0.835	-2.125	2.629
Constant	42.168	0.000	28.536	55.800

Notes: Model estimated using weighted linear regression in Stata; fixed effects for CCGs included but not shown; models estimated including robust standard errors; regression units are general practices

Table 7.3: regression analysis of % achieving treatment targets vs. characteristics of practice's diabetic populations - including care quality as an explanatory variable (2016-17 only)

N=438; Adj. R-squared: 0.178	Coefficient	P>t	[95% CI]	
% under 40	-0.365	0.013	-0.651	-0.079
% 65-79	0.131	0.166	-0.055	0.317
% 80 +	0.206	0.058	-0.007	0.420
% Female	-0.206	0.030	-0.391	-0.021
% Minority	0.044	0.062	-0.002	0.090
% Unknown	0.012	0.470	-0.021	0.046
% from most deprived 40%	0.021	0.314	-0.020	0.061
Registered diabetics (< 250) = 1	1.168	0.221	-0.707	3.044
Registered diabetics (500-749) = 1	-0.760	0.376	-2.444	0.924
Registered diabetics (750 +) = 1	0.128	0.915	-2.233	2.489
% receiving appropriate care	0.108	0.000	0.068	0.148
Constant	34.986	0.000	21.540	48.431

Notes: Model estimated using weighted linear regression in Stata; fixed effects for CCGs included but not shown; models estimated including robust standard errors; regression units are general practices

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