NPDA
National Paediatric Diabetes Audit

Appendices to the NPDA report on hospital admissions of children and young people with diabetes, 2015-20

Contents

Appendix I: Notes on the methodology

Building the dataset for analysis

Hospital admission data were obtained from three sources and triangulated to produce a combined dataset for all diabetes related admissions over a five-year audit period, 1st April 2015 – 31st March 2020:

1. **The NPDA dataset:** Hospital admissions submitted to the NPDA by PDUs as part of their annual submission of audit data.
2. **HES/PEDW dataset:** Hospital Episode Statistics for England (HES) and Patient Episode Database for Wales (PEDW) data obtained by linking NHS numbers of children and young people with diabetes submitted to the NPDA.

The NPDA dataset was limited to hospital admissions where the diagnosis was recorded as:

- Diabetic ketoacidosis
- Hypoglycaemia
- Stabilisation of diabetes
- Ketosis without acidosis

The HES/PEDW datasets were limited to admissions with specific ICD-10 codes related to diabetes as primary cause of admission and included:

- Diabetic ketoacidosis (ICD-10 code E10.1)
- Hypoglycaemia (ICD-10 codes E160, E161 and E16.2)
- Admissions 'without complications' (ICD- 10 code E10.9)
- Other diabetic complications (ICD-10 codes E100, E102-10.8)

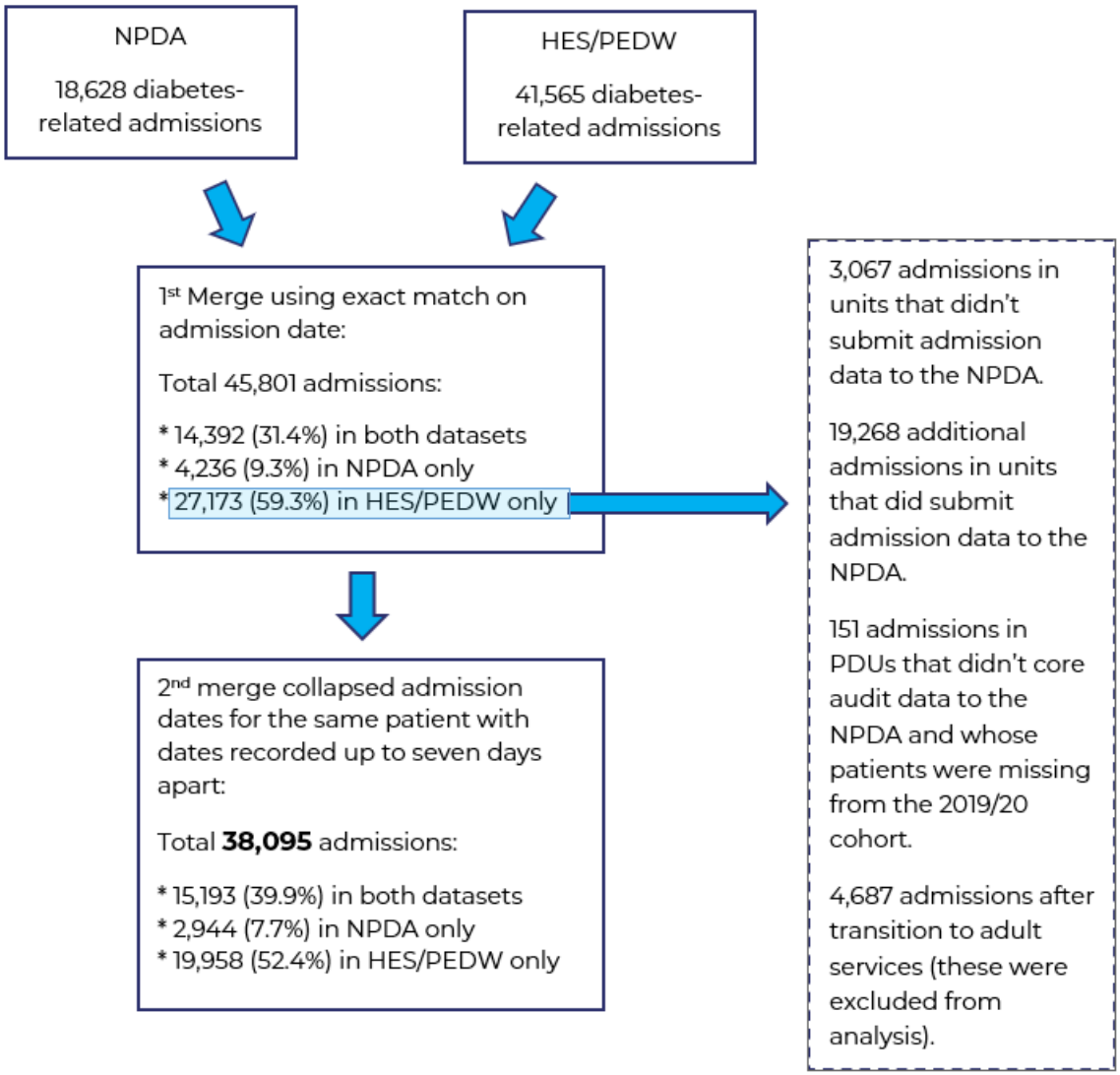
Datasets were cleaned and merged, matching on admission date and NHS number.

Data cleaning protocols applied within the NPDA core audit were applied to harmonise and aggregate patient demographic and clinical information where there were discrepancies recorded for the same patient across audit years or between datasets. HES/PEDW demographic information was used where the NPDA data was missing or unspecified. Consequently, the numbers and proportions of children and young people with diabetes in different demographic groups presented within this report may differ slightly compared to previous core NPDA reports.

Where several dates of admission and discharge were recorded for the same patient within seven days, the earliest dates of admission and discharge was selected for analysis. Where these dates were accompanied by different reasons for admission, the more acute reason was applied to the admission (e.g. diabetic ketoacidosis was selected over stabilization of diabetes).

In order to avoid double counting of admissions if admission dates differed between the data submitted by PDUs and the HES/PEDW data, all admissions recorded for the same patient within seven days were considered as a single admission, with the assumption being that discrepant dates were the result of miscoding rather than rapid subsequent readmissions. Figure 1 shows the process of identifying and excluding duplicate admissions, and identifying and excluding admissions recorded for patients whose admissions were recorded in the HES/PEDW datasets after they had left paediatric diabetes services.

Figure 1: Number of diabetes admissions within each dataset used to build the Masterfile used for admissions analysis, April 2015 – March 2020



A total of **38,095** hospital admissions were considered for analysis.

Categorising causes of admissions

Admission causes were recorded differently within the NPDA dataset and the HES/PEDW datasets.

Figure 2 shows the breakdown of admission causes recorded within the NPDA dataset, excluding surgical and 'other' causes, and Figure 26 presents a breakdown of admissions recorded within the HES/PEDW dataset.

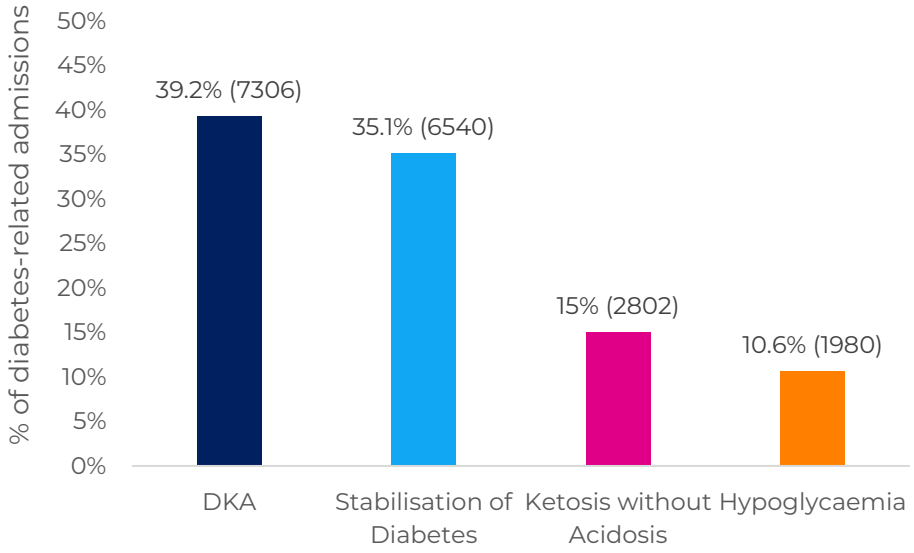


Figure 2: Percentage breakdown of admission causes recorded in the NPDA admissions dataset submitted by PDUs, for all types of diabetes, 2015/16-2019/20

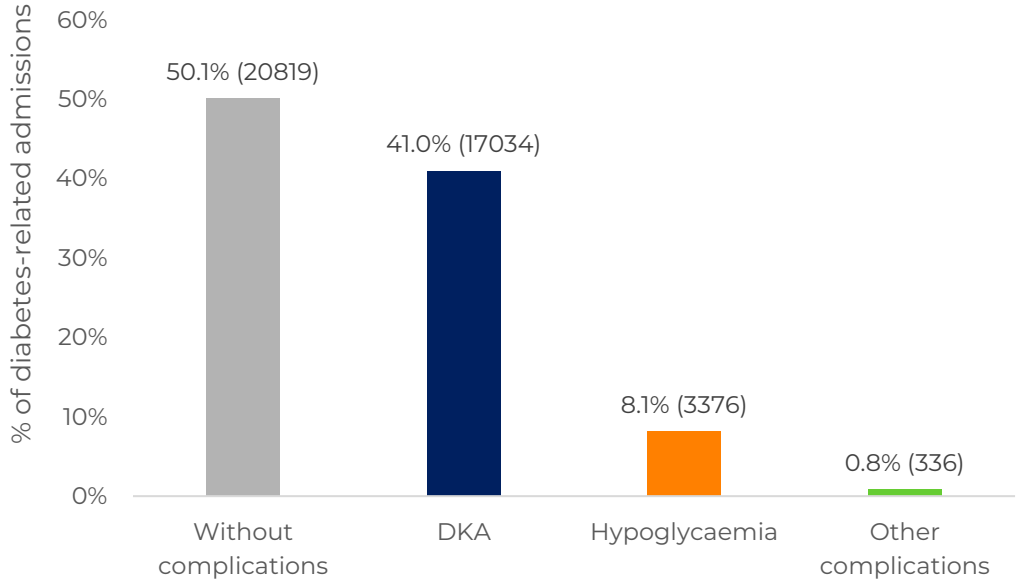


Figure 3: Percentage breakdown of admission causes recorded within the HES/PEDW dataset, for all types of diabetes, 2015/16-2019/20

Within the HES/PEDW dataset, the most common cause of admission recorded was admission 'without complications' (ICD-10 E109). Breakdown of the reasons for admission recorded in the NPDA for those admissions that were matched within the HES/PEDW and coded E109 showed that 64.8% corresponded to 'stabilization of diabetes' and 23.6% to 'ketosis without acidosis'.

Where a patient had a matching admission based on dates within both NPDA and HES/PEDW datasets but differing causes of admission recorded, the reason taken through to analysis was aggregated in the following order:

1. Diabetic ketoacidosis,

2. Hypoglycaemia,

3. Admissions 'without complications', including code E109 from HES/PEDW, and 'stabilization of diabetes' and 'ketosis without acidosis' from the NPDA,

4. Admissions with 'other diabetic complications', including codes E100, E102-108 from HES/PEDW

The category ‘without complications’ aggregates the categories of ketosis without acidosis and stabilisation of diabetes within the NPDA dataset, and the code E109 “admissions without complications” within the HES/PEDW dataset.

The category ‘other diabetic complications’ aggregates admissions coded E100, E102-108, referring to diabetes with coma, renal complications, ophthalmic complications, neurological complications, peripheral circulatory complications and multiple complications, within the HES/PEDW dataset.

Differences in methodology between this report and the 2012-15 NPDA admissions report

The 2012-2015 NPDA admissions report (RCPCH, 2017) included all causes of admission within the NPDA dataset, whereas the current report excludes ‘Other causes’ and ‘surgical procedures’ reported by PDUs (about 40% of all admissions recorded within the NPDA dataset). Scrutiny of these data suggested that not all admissions coded under these reasons within the NPDA dataset were related to the patients’ diabetes.

The methodology for identifying duplicate admissions recorded in both the NPDA and HES/PEDW datasets in the previous report used exact matches on admission dates, whereas the methodology used for the analysis presented within this report has been improved to allow a tolerance of seven days between admission dates for the same patient recorded in different datasets to allow for discrepancies in coding between the three data sources and to reduce the risk of double counting admissions. Multiple different admission of the same patient within 7 days would be unusual.

This methodology is different to previous NPDA reports on hospital admissions and therefore direct comparisons cannot be made.

Appendix II- All cause diabetes-related admissions breakdown by region

Table 1: Total number and percentage of all diabetes-related admissions by country, regional network, NHS England regions, and overall, by audit year (2015-2020)

	2015/16 (n)	2016/17 (n)	2017/18 (n)	2018/19 (n)	2019/20 (n)	2019/20 (%)
England and Wales	7,310	7,847	7,627	7,651	7,660	100.0%
England	6,857	7,321	7,174	7,198	7,222	94.3%
Wales	453	526	453	453	438	5.7%
Regional network						
East Midlands	422	450	463	456	471	6.1%
East of England	794	887	826	785	848	11.1%
London and South East	1636	1733	1641	1615	1603	20.9%
North East and North Cumbria	370	409	384	391	386	5.0%
North West	1118	1218	1276	1192	1086	14.2%
South Central	528	513	570	564	668	8.7%
South West	619	637	583	635	596	7.8%
West Midlands	669	733	694	754	777	10.1%
Yorkshire and Humber	701	741	737	806	787	10.3%
NHSE Region						
East of England	820	923	875	826	879	11.5%
London	1078	1105	1057	1067	1047	13.7%
Midlands	1091	1183	1157	1210	1248	16.3%
North East and Yorkshire	1071	1150	1121	1197	1173	15.3%
North West	1118	1218	1276	1192	1086	14.2%
South East	1047	1083	977	955	1055	13.8%
South West	623	632	673	724	711	9.3%
Missing NHS region	9	27	38	27	23	0.3%

Appendix III – Breakdown of DKA admissions

Table 2: Percentage and number of DKA admissions at diagnosis, and not at diagnosis, amongst children and young people with Type 1 diabetes in different audit periods, broken down by patient characteristics, 2015/16- 2019/20 (denominator = all DKA admissions)

Patient characteristic	2015-16		2016-17		2017-18		2018-19		2019-20	
	%(n) DKA not at diagnosis	%(n) DKA at diagnosis	%(n) DKA not at diagnosis	%(n) DKA at diagnosis	%(n) DKA not at diagnosis	%(n) DKA at diagnosis	%(n) DKA not at diagnosis	%(n) DKA at diagnosis	%(n) DKA not at diagnosis	%(n) DKA at diagnosis
Country										
England and Wales	66% (1713/2595)	34% (882/2595)	68.3% (2073/3037)	31.7% (964/3037)	64.8% (1900/2930)	35.2% (1030/2930)	64.5% (1784/2765)	35.5% (981/2765)	62.7% (1905/3036)	37.3% (1131/3036)
England	65% (1585/2440)	35% (855/2440)	67.6% (1905/2818)	32.4% (913/2818)	64.5% (1784/2765)	35.5% (981/2765)	63.7% (1794/2816)	36.3% (1022/2816)	62.5% (1802/2882)	37.5% (1080/2882)
Wales	82.6% (128/155)	17.4% (27/155)	76.7% (168/219)	23.3% (51/219)	70.3% (116/165)	29.7% (49/165)	69.1% (105/152)	30.9% (47/152)	66.9% (103/154)	33.1% (51/154)
Sex										
Male	60.9% (737/1210)	39.1% (473/1210)	63.8% (876/1372)	36.2% (496/1372)	60.7% (861/1419)	39.3% (558/1419)	57.3% (799/1395)	42.7% (596/1395)	56.6% (812/1435)	43.4% (623/1435)
Female	70.5% (976/1385)	29.5% (409/1385)	71.9% (1197/1665)	28.1% (468/1665)	68.8% (1039/1510)	31.2% (471/1510)	69.9% (1100/1573)	30.1% (473/1573)	68.3% (1093/1601)	31.7% (508/1601)
Age on 1st day of audit										
0-4 years	24% (70/292)	76% (222/292)	18.7% (52/278)	81.3% (226/278)	16.6% (45/271)	83.4% (226/271)	17.6% (54/306)	82.4% (252/306)	20.5% (60/292)	79.5% (232/292)
5-9 years	38.3% (164/428)	61.7% (264/428)	38.9% (190/488)	61.1% (298/488)	34.6% (169/489)	65.4% (320/489)	27% (124/459)	73% (335/459)	25.6% (125/488)	74.4% (363/488)
10-14 years	68.4% (726/1061)	31.6% (335/1061)	68.6% (754/1099)	31.4% (345/1099)	61.6% (661/1073)	38.4% (412/1073)	61.7% (638/1034)	38.3% (396/1034)	60.3% (657/1090)	39.7% (433/1090)
15-24 years	92.5% (753/814)	7.5% (61/814)	91.9% (1077/1172)	8.1% (95/1172)	93.4% (1025/1097)	6.6% (72/1097)	92.6% (1083/1169)	7.4% (86/1169)	91.2% (1063/1166)	8.8% (103/1166)

Patient characteristic	2015-16		2016-17		2017-18		2018-19		2019-20	
	%(n) DKA not at diagnosis	%(n) DKA at diagnosis	%(n) DKA not at diagnosis	%(n) DKA at diagnosis	%(n) DKA not at diagnosis	%(n) DKA at diagnosis	%(n) DKA not at diagnosis	%(n) DKA at diagnosis	%(n) DKA not at diagnosis	%(n) DKA at diagnosis
Ethnicity										
White	66.5% (1442/2168)	33.5% (726/2168)	70.1% (1783/2543)	29.9% (760/2543)	66.5% (1599/2405)	33.5% (806/2405)	66.5% (1633/2457)	33.5% (824/2457)	64.6% (1598/2473)	35.4% (875/2473)
Asian	60.3% (79/131)	39.7% (52/131)	52.1% (75/144)	47.9% (69/144)	54.3% (89/164)	45.7% (75/164)	47.2% (68/144)	52.8% (76/144)	48.8% (78/160)	51.3% (82/160)
Black	74.1% (83/112)	25.9% (29/112)	68.2% (105/154)	31.8% (49/154)	71.5% (108/151)	28.5% (43/151)	65.5% (95/145)	34.5% (50/145)	68.1% (111/163)	31.9% (52/163)
Mixed	65.9% (54/82)	34.1% (28/82)	65.5% (57/87)	34.5% (30/87)	52.6% (51/97)	47.4% (46/97)	51% (51/100)	49% (49/100)	61.1% (69/113)	38.9% (44/113)
Other	60.4% (32/53)	39.6% (21/53)	56.9% (41/72)	43.1% (31/72)	58.3% (35/60)	41.7% (25/60)	49.1% (27/55)	50.9% (28/55)	59% (36/61)	41% (25/61)
Not stated or missing	66.5% (23/49)	33.5% (26/49)	70.1% (12/37)	29.9% (25/37)	66.5% (18/53)	33.5% (35/53)	66.5% (25/67)	33.5% (42/67)	64.6% (13/66)	35.4% (53/66)
Deprivation quintile										
1=Most deprived	70.2% (529/754)	29.8% (225/754)	69.6% (612/879)	30.4% (267/879)	66.1% (593/897)	33.9% (304/897)	68.7% (638/929)	31.3% (291/929)	67.9% (629/927)	32.1% (298/927)
2	67.7% (431/637)	32.3% (206/637)	72% (524/728)	28% (204/728)	68.6% (453/660)	31.4% (207/660)	64.3% (436/678)	35.7% (242/678)	62.9% (448/712)	37.1% (264/712)
3	69% (323/468)	31% (145/468)	68.6% (394/574)	31.4% (180/574)	62.5% (330/528)	37.5% (198/528)	65.6% (354/540)	34.4% (186/540)	61.9% (348/562)	38.1% (214/562)
4	57.1% (216/378)	42.9% (162/378)	65.7% (307/467)	34.3% (160/467)	64.9% (314/484)	35.1% (170/484)	56.4% (260/461)	43.6% (201/461)	59.7% (253/424)	40.3% (171/424)
5=Least deprived	59.9% (214/357)	40.1% (143/357)	60.7% (235/387)	39.3% (152/387)	58.3% (210/360)	41.7% (150/360)	58.6% (211/360)	41.4% (149/360)	55.5% (226/407)	44.5% (181/407)

Table 3: Regional breakdown of numbers of children and young people diagnosed with Type 1 diabetes within each audit year, and number of cases of DKA at diagnosis within each region, 2015/16-2019/20

Region	2015-16	2016-17	2017-18	2018-19	2019-20
England and Wales	29.3% (882/3010)	32.3% (960/2973)	34.9% (1024/2936)	36.6% (1065/2913)	38.5% (1131/2936)
England	29.8% (855/2871)	32.2% (909/2824)	35.1% (975/2780)	36.8% (1018/2764)	38.9% (1080/2774)
Wales	19.4% (27/139)	34.2% (51/149)	31.4% (49/156)	31.5% (47/149)	31.5% (51/162)
Regional Network					
East of England	24.5% (51/208)	32.9% (70/213)	33.3% (62/186)	38.3% (77/201)	46.2% (108/234)
East Midlands	31.8% (110/346)	29.5% (104/352)	33.2% (114/343)	37.6% (115/306)	36.5% (124/340)
London and South East	31.2% (202/648)	37.4% (266/712)	35.3% (234/662)	42.4% (255/602)	44% (277/629)
North East & North Cumbria	26.8% (45/168)	23.6% (39/165)	21.3% (33/155)	32.9% (52/158)	32% (49/153)
North West	27.2% (94/345)	25.9% (92/355)	35.4% (136/384)	37.5% (138/368)	35% (118/337)
South Central	36.1% (90/249)	32.8% (75/229)	30.5% (79/259)	30.7% (69/225)	36.5% (109/299)
South West	29.5% (83/281)	27.2% (64/235)	38.5% (85/221)	35.3% (97/275)	42.1% (88/209)
West Midlands	30.1% (96/319)	30.6% (88/288)	39.4% (119/302)	30.1% (103/342)	31.5% (97/308)
Yorkshire and The Humber	27.4% (84/307)	40.4% (111/275)	42.2% (113/268)	39% (112/287)	41.5% (110/265)
NHS Network					
East of England	32.1% (118/368)	29.2% (108/370)	33.4% (122/365)	37.3% (119/319)	36.3% (129/355)
London	31.1% (126/405)	36.2% (162/447)	34.4% (137/398)	43.8% (162/370)	44.3% (167/377)
Midlands	27.9% (147/527)	31.5% (158/501)	37.1% (181/488)	33.1% (180/543)	37.8% (205/542)
North East and Yorkshire	27.2% (129/475)	34.1% (150/440)	34.5% (146/423)	36.9% (164/445)	38% (159/418)
North West	27.2% (94/345)	25.9% (92/355)	35.4% (136/384)	37.5% (138/368)	35% (118/337)
South East	32.2% (151/469)	37.6% (169/450)	33.9% (148/436)	37.3% (146/391)	40.2% (187/465)
South West	31.7% (88/278)	27% (67/248)	35.6% (98/275)	33.4% (108/323)	41.1% (109/265)
Missing NHS Region	50% (2/4)	23.1% (3/13)	63.6% (7/11)	20% (1/5)	40% (6/15)

Table 4: Percentage and number of admissions related to DKA at diagnosis, broken down by patient characteristics, 2015/16-2019/20 (denominator = all children and young people with Type 1 diabetes diagnosed within the audit year)

Patient characteristic	2015-16	2016-17	2017-18	2018-19	2019-20
Country					
England and Wales	29.3% (882/3010)	32.3% (960/2973)	34.9% (1024/2936)	36.6% (1065/2913)	38.5% (1131/2936)
England	29.8% (855/2871)	32.2% (909/2824)	35.1% (975/2780)	36.8% (1018/2764)	38.9% (1080/2774)
Wales	19.4% (27/139)	34.2% (51/149)	31.4% (49/156)	31.5% (47/149)	31.5% (51/162)
Sex					
Male	29.4% (473/1611)	31.3% (494/1578)	35.4% (554/1565)	37.8% (594/1571)	39.4% (623/1581)
Female	29.2% (409/1399)	33.4% (466/1394)	34.2% (469/1370)	35.1% (471/1342)	37.5% (508/1355)
Age group					
0-4 years	35.6% (222/624)	40.3% (225/559)	43.7% (226/517)	45.3% (251/554)	44.5% (232/521)
5-9 years	26.9% (264/980)	28.5% (297/1042)	30.9% (317/1027)	33.4% (332/995)	35.3% (363/1028)
10-14 years	30% (335/1117)	31% (343/1108)	35.3% (410/1163)	35.8% (396/1106)	37.7% (433/1150)
15-24 years	21.1% (61/289)	36% (95/264)	31% (71/229)	33.3% (86/258)	43.5% (103/237)
Ethnicity					
White	34.8% (726/2087)	36.2% (757/2094)	38% (801/2109)	37.2% (821/2208)	39.6% (875/2210)
Asian	43% (52/121)	43.9% (69/157)	45.7% (75/164)	38.4% (76/198)	42.7% (82/192)
Black	28.2% (29/103)	43.2% (48/111)	41% (43/105)	47.2% (50/106)	48.6% (52/107)
Mixed	40.6% (28/69)	39.5% (30/76)	49.5% (46/93)	49.5% (49/99)	53.7% (44/82)
Other	45.7% (21/46)	56.4% (31/55)	36.4% (24/66)	40.9% (27/66)	36.2% (25/69)
Not stated/unknown*	4.5% (26/584)	1.3% (6/480)	8.9% (35/395)	18.3% (42/229)	19.2% (53/276)
Deprivation quintile					
1=Most deprived	33.5% (225/671)	36.7% (266/724)	42.5% (303/713)	42.1% (291/691)	42.7% (298/698)
2	31.7% (206/649)	33.6% (201/598)	34.3% (205/597)	41.8% (241/577)	42% (264/628)
3	25.8% (145/562)	30.5% (180/591)	35.6% (197/553)	32.6% (186/571)	36.5% (214/587)
4	29.4% (162/551)	30% (160/534)	31.9% (168/526)	34.9% (199/570)	32.8% (171/522)
5=Least deprived	24.9% (143/575)	29.2% (152/520)	27.5% (150/545)	29.4% (148/503)	36.5% (181/496)

* Does not include “not stated” for 2016/17 due to incomplete data.

Table 5: Percentage and number of children and young people with Type 1 diabetes admitted to hospital with DKA at least once, not at diagnosis, by patient characteristic, 2019/20 (denominator = number of children and young people with Type 1 diabetes in each audit year)

Patient characteristic	2015-16	2016-17	2017-18	2018-19	2019-20
Country					
England and Wales	4.8% (1301/27229)	5.2% (1445/27860)	4.7% (1342/28403)	4.6% (1328/28697)	4.6% (1279/27733)
England	4.6% (1201/25855)	5.1% (1340/26409)	4.6% (1253/26957)	4.6% (1248/27259)	4.6% (1202/26321)
Wales	7.3% (100/1374)	7.2% (105/1451)	6.2% (89/1446)	5.6% (80/1438)	5.5% (77/1412)
Sex					
Male	4% (579/14305)	4.3% (631/14588)	4.1% (617/14881)	3.9% (578/14968)	3.9% (571/14507)
Female	5.6% (722/12908)	6.1% (814/13258)	5.4% (725/13507)	5.5% (750/13719)	5.4% (708/13218)
Age group					
0-4 years	3.9% (65/1673)	3% (50/1671)	2.6% (42/1590)	3.4% (53/1543)	3.8% (55/1455)
5-9 years	2.4% (145/5944)	2.6% (163/6234)	2.4% (152/6326)	1.9% (115/6210)	1.8% (108/5913)
10-14 years	5.1% (561/11000)	5.1% (564/11086)	4.5% (514/11476)	4.2% (498/11856)	4.2% (495/11712)
15-24 years	6.2% (530/8611)	7.5% (668/8869)	7% (634/9011)	7.3% (662/9088)	7.2% (621/8653)
Ethnicity					
White	5.5% (1097/19999)	5.9% (1230/20895)	5.1% (1138/22224)	5% (1134/22784)	4.8% (1076/22197)
Asian	4.9% (62/1266)	3.8% (55/1435)	4% (62/1556)	3.2% (58/1824)	3.2% (56/1747)
Black	6.8% (57/836)	7.7% (74/962)	7.1% (72/1021)	6.1% (64/1048)	6.4% (68/1061)
Mixed	6.7% (42/626)	6.1% (43/702)	4.5% (33/737)	3.9% (33/840)	5.5% (47/853)
Other	6% (24/403)	7.6% (32/423)	3.3% (21/641)	3.6% (19/531)	4.2% (23/547)
Not stated/unknown*	0.5% (19/3953)	0% (1/3443)	0.7% (16/2203)	1.2% (20/1613)	0.7% (9/1328)
Deprivation quintile					
1=Most deprived	6.6% (390/5884)	6.8% (413/6113)	6.5% (406/6285)	6.3% (408/6485)	6.4% (410/6387)
2	5.6% (304/5458)	6.1% (343/5606)	5.5% (311/5702)	5.5% (313/5740)	5.3% (298/5611)
3	4.6% (240/5215)	5.2% (275/5339)	4.4% (236/5378)	4.8% (261/5434)	4.5% (240/5286)
4	3.5% (183/5294)	4.3% (231/5375)	4.1% (226/5470)	3.5% (192/5505)	3.2% (167/5162)
5=Least deprived	3.4% (184/5361)	3.4% (182/5400)	2.9% (163/5537)	2.8% (154/5520)	3.1% (163/5267)
Duration of diabetes on day 1 of the audit year					
Less than 1 year	1.9% (113/6018)	1.9% (117/6219)	1.9% (117/6098)	1.9% (114/5963)	1.9% (111/5836)
1-2 years	4.7% (271/5796)	4.7% (274/5816)	4.1% (247/6059)	3.9% (240/6162)	3.9% (225/5744)
3-4 years	5.6% (271/4816)	5.9% (294/5009)	5.7% (292/5098)	5.1% (260/5144)	5.1% (259/5080)
5-9 years	5.9% (439/7437)	6.7% (506/7555)	5.9% (463/7813)	6.3% (504/8049)	6.1% (483/7879)
10+ years	6.6% (206/3141)	7.8% (254/3237)	6.7% (221/3312)	6.2% (209/3351)	6.2% (197/3165)
Treatment regimen					
One - three injections/day*	6% (105/1752)	8.4% (81/963)	6.8% (120/1768)	6.5% (64/989)	5.8% (43/736)
Four or more injections/day*	5.1% (743/14701)	5.3% (894/16896)	5.2% (828/15941)	5.2% (859/16615)	5.1% (818/15981)
Insulin pump**	4.6% (352/7630)	4.5% (410/9032)	3.5% (337/9705)	3.5% (355/10186)	3.7% (383/10225)
Missing/Invalid	3.1% (78/2509)	6.2% (60/969)	5.8% (56/960)	5.7% (50/879)	4.6% (35/759)
HbA1c median in audit year					
≤ 48 mmol/mol	0.7% (11/1675)	0.7% (13/1990)	0.5% (9/1946)	0.4% (11/2811)	0.7% (21/2810)
≤ 53 mmol/mol	1.1% (40/3764)	1.2% (50/4302)	0.7% (32/4341)	0.7% (41/5889)	1% (60/5797)
< 58 mmol/mol	1.2% (82/6810)	1.4% (109/7642)	0.9% (71/7682)	1% (97/9753)	1.3% (120/9496)
≥ 69 mmol/mol	9.5% (944/9898)	10.7% (1038/9682)	10.1% (990/9825)	10.9% (909/8330)	10.9% (879/8052)
> 75 mmol/mol	12.2% (765/6267)	14% (853/6083)	13.4% (827/6152)	14.4% (753/5215)	14.7% (745/5053)
> 80 mmol/mol	14.3% (655/4582)	16.6% (717/4310)	15.7% (693/4413)	17% (650/3816)	17.1% (627/3661)

Appendix IV- Hypoglycaemia admissions breakdown

Table 6 shows numbers of hypoglycaemia admissions and the percentages of those with Type 1 diabetes admitted due to hypoglycaemia, broken down by patient characteristics. The denominator for this sub-section is all children and young people with Type 1 diabetes in the NPDA; the numerator is the number of patients who were admitted with hypoglycaemia at least once during the audit period, broken down by socio-demographics, HbA1c group and time since diagnosis.

Table 6: Percentage and number of children and young people with Type 1 diabetes admitted to hospital with hypoglycaemia at least once in each audit year as a proportion of the total number of those with Type 1 diabetes, by socio-demographic characteristics and diabetes characteristics , 2015/16-2019/20

	2015/16	2016/17	2017/18	2018/19	2019/20*
	%(n)	%(n)	%(n)	%(n)	%(n)
Country					
England and Wales	2.3 (625/27229)	2.6 (713/27860)	2.6 (741/28403)	2.4 (688/28697)	2.2 (622/27733)
England	2.2 (570/25855)	2.5 (654/26409)	2.6 (691/26957)	2.3 (640/27259)	2.2 (577/26321)
Wales	4 (55/1374)	4.1 (59/1451)	3.5 (50/1446)	3.3 (48/1438)	3.2 (45/1412)
Age group					
0-4 years	6.2 (103/1674)	6.4 (107/1671)	6.9 (109/1590)	5.9 (91/1543)	6.3 (92/1455)
5-9 years	2.9 (171/5944)	2.8 (175/6234)	2.8 (178/6326)	3.0 (189/6210)	2.9 (171/5913)
10-14 years	2.3 (253/11000)	2.6 (289/11086)	2.8 (318/11476)	2.4 (279/11856)	2.1 (243/11712)
15-19 years	1.1 (98/8583)	1.6 (142/8850)	1.5 (136/8996)	1.4 (128/9060)	1.3 (116/8642)
Sex					
Male	2.1 (303/14305)	2.4 (345/14588)	2.3 (344/14881)	2.4 (354/14968)	2.1 (299/14507)
Female	2.5 (322/12908)	2.8 (368/13258)	2.9 (397/13507)	2.4 (334/13719)	2.4 (323/13218)
Ethnicity					
White	2.3 (464/19999)	2.6 (542/20895)	2.6 (588/22224)	2.3 (517/22784)	2.3 (503/22197)
Asian	2.5 (32/1266)	2.7 (39/1435)	2.8 (44/1556)	3.1 (56/1824)	2.5 (44/1747)
Black	2.9 (24/836)	2.2 (21/962)	3.0 (31/1021)	3.5 (37/1048)	2.9 (31/1061)
Mixed	2.9 (18/626)	3.0 (21/702)	2.7 (20/737)	3.5 (29/840)	1.6 (14/853)
Other	3.2 (13/403)	2.4 (10/423)	1.9 (12/641)	3.6 (19/531)	1.6 (9/547)
Deprivation quintile					
Most deprived	3.3 (194/5884)	3.5 (213/6113)	3.4 (213/6285)	2.9 (186/6485)	2.7 (171/6387)
Second most deprived	2.5 (136/5458)	2.6 (148/5606)	2.8 (159/5702)	2.9 (167/5740)	2.3 (131/5611)
Third least deprived	2.3	2.3	2.5	2.5	2.4

	(122/5215)	(123/5339)	(136/5378)	(135/5434)	(129/5286)
Second least deprived	1.7 (90/5294)	2.2 (116/5375)	2.3 (126/5470)	1.7 (96/5505)	2.1 (110/5162)
Least deprived	1.5 (83/5361)	2.1 (112/5400)	1.9 (107/5537)	1.9 (104/5520)	1.5 (81/5267)
Duration of diabetes					
Less than one year	2.6 (158/6018)	3.2 (197/6219)	3.0 (185/6098)	2.9 (172/5963)	3.2 (185/5836)
1-2 years	3.0 (173/5796)	2.8 (160/5816)	3.0 (179/6059)	2.5 (155/6162)	2.4 (137/5744)
3-4 years	2.2 (104/4816)	2.6 (131/5009)	2.7 (136/5098)	2.4 (124/5144)	2.0 (101/5080)
5-9 years	1.8 (134/7437)	2.1 (162/7555)	2.2 (172/7813)	2.1 (169/8049)	1.9 (151/7879)
10-14 years	1.9 (53/2852)	2.1 (61/2932)	2.2 (66/2999)	2.1 (63/2992)	1.6 (45/2834)
HbA1c median (groups)					
≤48 mmol/mol	1.4 (23/1675)	2.6 (52/1990)	1.4 (28/1946)	1.5 (41/2811)	1.6 (46/2810)
≤53 mmol/mol	1.8 (66/3764)	2.4 (105/4302)	2.0 (85/4341)	1.7 (103/5889)	1.9 (109/5797)
<58 mmol/ mol	1.9 (131/6810)	2.5 (188/7642)	2.0 (155/7682)	2.1 (205/9753)	1.9 (176/9496)
≥69 mmol/mol	2.5 (252/9898)	2.8 (270/9682)	3.0 (292/9825)	2.7 (229/8330)	2.8 (222/8052)
> 75 mmol/mol	2.4 (148/6267)	2.6 (161/6083)	2.7 (168/6152)	2.8 (148/5215)	2.8 (141/5053)
> 80 mmol/ mol	2.2 (103/4582)	2.4 (103/4310)	2.6 (116/4413)	2.5 (94/3816)	2.8 (102/3661)

* Excludes all children within the 7 units that didn't submit data to the NPDA in 2019/20.

Appendix V- Regression output for hypoglycaemia admissions using a generalized structural equation model (GSEM), 2015/16 - 2019/20

This patient-level analysis explored associations of socio-demographic and diabetes-related characteristics of all children and young people with Type 1 diabetes and admission for hypoglycaemia, combining data for all audit years. The analysis is based on a generalized structural equation model (GSEM), where the socio-demographic characteristics and the use of technology can impact the probability of hypoglycaemia admissions both directly, and through their influence on the median HbA1c. The specified GSEM included a Logistic regression for the occurrence of hypoglycaemia admissions, and an ordered Logit for a second equation where the dependent variable is the HbA1c targets.

The table below shows the estimated coefficients (or logarithm of the odds) for both equations, the marginal effects (interpreted as the relative change from the reference group), the predicted probability of being admitted for the reference groups and for the interaction between HbA1c and diabetes-related technologies.

Table 7: Output table for the generalized structural equation model considering patient factors associated with hypoglycaemia admission

		Estimated coefficient	95% Confidence Interval	P-value	Marginal effects	Predicted probability
Model 1: Logistic regression Dependent variable: Hypoglycaemia admission (binary)						
Age	0-4 years old	-	-	-	-	6.6%
	5-9 years old	-0.79288	-0.92--0.67	<0.000	-3.5%	
	10-14 years old	-1.02158	-1.15--0.89	<0.000	-4.1%	
	15-24 years old	-1.60691	-1.76--1.45	<0.000	-5.2%	
Sex	Male	-	-	-	-	2.4%
	Female	0.125905	0.05-0.2	0.001	0.3%	
Duration of diabetes	<1 year	-	-	-	-	2.4%
	1-2 years	0.023734	-0.08-0.13	0.667	0.1%	
	3-4 years	0.042176	-0.08-0.16	0.498	0.1%	
	5-9 years	0.013012	-0.11-0.13	0.831	0.0%	
	10+ years	0.150851	-0.01-0.31	0.063	0.4%	
Deprivation	Most deprived	-	-	-	-	3.1%
	2nd most deprived	-0.13523	-0.24--0.03	0.01	-0.4%	
	3rd least deprived	-0.20545	-0.31--0.1	<0.000	-0.6%	

	2nd least deprived	-0.39187	-0.51--0.28	<0.000	-1.0%	
	least deprived	-0.50931	-0.63--0.39	<0.000	-1.2%	
Ethnic group	White	-	-	-	-	2.5%
	Asian	-0.03832	-0.18-0.11	0.604	-0.1%	
	Black	0.004439	-0.17-0.18	0.96	0.0%	
	Mixed	-0.05633	-0.27-0.15	0.599	-0.1%	
	Other	-0.13528	-0.4-0.13	0.31	-0.3%	
Treatment and CGM	Injections alone	-	-	-	-	2.6%
	Injections plus rtCGM	0.188822	-0.19-0.57	0.335*	1.7%	
	Pump alone	-0.13638	-0.3-0.03	0.1	-0.4%	
	Pump plus rtCGM	-0.15953	-0.41-0.09	0.207*	0.1%	
Mean HbA1c	<58 mmol/mol	-	-	-	-	2.1%
	58-79 mmol/mol	0.253867	0.14-0.37	<0.000	0.6%	
	≥80 mmol/mol	0.260369	0.12-0.4	<0.000	0.7%	
Treatment, CGM and HbA1c group interactions	Injections alone and HbA1c <58 mmol/mol	-	-	-	-	2.2%
	Injections alone and HbA1c 58-79 mmol/mol	-	-	-	-	2.8%
	Injections alone and HbA1c ≥80 mmol/mol	-	-	-	-	2.8%
	Injections+rtCGM and HbA1c <58 mmol/mol	-	-	-	-	2.6%
	Injections+rtCGM and HbA1c 58-79 mmol/mol	0.364585	-0.1-0.83	0.125*		4.7%
	Injections+rtCGM and HbA1c ≥80 mmol/mol	0.620275	0.02-1.22	0.042*		6.0%
	Pump alone and HbA1c <58 mmol/mol	-	-	-	-	1.9%
	Pump alone and	-0.07918	-0.27-0.11	0.423		2.3%

	HbA1c 58-79 mmol/mol					
	Pump alone and HbA1c ≥80 mmol/mol	-0.01275	-0.31-0.29	0.933		2.4%
	Pump+rtCGM and HbA1c <58 mmol/mol	-	-	-	-	1.9%
	Pump+rtCGM and HbA1c 58-79 mmol/mol	0.310368	0-0.62	0.052*		3.2%
	Pump+rtCGM and HbA1c ≥80 mmol/mol	0.042439	-0.82-0.9	0.923*		2.5%
	Constant	-2.65522	-2.81--2.5	<0.000		
Model 2: ordered Logit **Dependent variable: HbA1c groups (ordinal)**						
Age	0-4 years old	-	-	-	-	
	5-9 years old	-0.5588	-0.61--0.5	<0.000		
	10-14 years old	-0.19674	-0.25--0.14	<0.000		
	15-24 years old	0.086772	0.03-0.14	0.002		
Sex	Male	-	-	-	-	
	Female	0.126439	0.1-0.15	<0.000		
Duration of diabetes	<1 year	-	-	-	-	
	1-2 years	0.366731	0.33-0.4	<0.000		
	3-4 years	0.661216	0.62-0.7	<0.000		
	5-9 years	0.858427	0.82-0.89	<0.000		
	10+ years	1.042603	1-1.09	<0.000		
Deprivation	Most deprived	-	-	-	-	
	2nd most deprived	-0.19808	-0.23--0.16	<0.000		
	3rd least deprived	-0.30145	-0.34--0.27	<0.000		
	2nd least deprived	-0.44932	-0.48--0.41	<0.000		
	least deprived	-0.61459	-0.65--0.58	<0.000		
	White	-	-	-	-	

Ethnic group	Asian	0.072187	0.03-0.12	0.002		
	Black	0.468127	0.41-0.53	<0.000		
	Mixed	0.23877	0.17-0.3	<0.000		
	Other	-0.10432	-0.18--0.03	0.009		
Treatment and CGM	Injections alone	-	-	-	-	
	Injections plus rtCGM	-0.5565	-0.64--0.48	<0.000		
	Pump alone	-0.69251	-0.72--0.67	<0.000		
	Pump plus rtCGM	-1.31565	-1.37--1.27	<0.000		
N = 121,340 includes all children and young people with Type 1 diabetes reported to the NPDA, with a valid record for all the variables included.						

* The significance of the use of rtCGM should be interpreted with caution since there was no information about its use in the first two years of analysis, and less than 20% of all children and young people with Type 1 diabetes was using one in the last three years of analysis (9.4% in 2017/18 – 19.4% in 2019/20). The relatively small sample is associated with higher standard errors affecting the analysis of significance.

Appendix VI- Regression output for DKA admission (not at diagnosis) using a generalized structural equation model (GSEM), 2015/16 - 2019/20

This patient-level analysis explored associations of socio-demographic and diabetes-related characteristics of all children and young people with Type 1 diabetes and admission for DKA (excluding at diagnosis), combining data for all audit years. The analysis is based on a generalized structural equation model (GSEM), where the socio-demographic characteristics and the use of technology can impact the probability of DKA admission both directly, and through their influence on the median HbA1c. The specified GSEM included a Logistic regression for the occurrence of DKA admissions, and an ordered Logit for a second equation where the dependent variable is the HbA1c targets.

The table below shows the estimated coefficients (or logarithm of the odds) for both equations, the marginal effects (interpreted as the relative change from the reference group), and the predicted probability for each variable.

Table 8: Output table for the generalized structural equation model considering patient factors associated with admission with DKA, not at diagnosis, 2015/16-2019/20.

		Estimated coefficient	95% Confidence Interval	P-value	Marginal effects	Predicted probability
Model 1: Logistic regression **Dependent variable: DKA admission (binary)**						
Age	0-4 years old	-	-	-	-	6.2%
	5-9 years old	-0.64278	-0.8--0.48	<0.000	-2.7%	
	10-14 years old	-0.28749	-0.44--0.14	<0.000	-1.4%	
	15-24 years old	-0.17688	-0.33--0.02	0.025	-0.9%	
Sex	Male	-	-	-	-	4.2%
	Female	0.326306	0.27-0.38	<0.000	1.4%	
Duration of diabetes	<1 year	-	-	-	-	2.3%
	1-2 years	0.868277	0.75-0.98	<0.000	2.8%	
	3-4 years	1.001803	0.88-1.12	<0.000	3.5%	
	5-9 years	0.963632	0.85-1.08	<0.000	3.3%	
	10+ years	0.855521	0.73-0.98	<0.000	2.8%	
Deprivation	Most deprived	-	-	-	-	6.1%
	2nd most deprived	-0.13892	-0.21--0.06	<0.000	-0.7%	
	3rd least deprived	-0.26694	-0.35--0.19	<0.000	-1.3%	
	2nd least deprived	-0.46911	-0.56--0.38	<0.000	-2.1%	
	least deprived	-0.59167	-0.68--0.5	<0.000	-2.5%	
Ethnic group	White	-	-	-	-	5.1%
	Asian	-0.55911	-0.69--0.43	<0.000	-2.0%	
	Black	-0.22108	-0.35--0.09	0.001	-0.9%	
	Mixed	-0.25338	-0.42--0.09	0.003	-1.0%	
	Other	-0.28274	-0.49--0.07	0.008	-1.2%	
Treatment and CGM	Injections alone	-	-	-	-	4.7%
	Injections plus rtCGM	0.142467	-0.53-0.82	0.679*	0.0%	
	Pump alone	0.554841	0.35-0.76	<0.000	0.0%	

	Pump plus rtCGM	0.08821	-0.26-0.44	0.623*	-1.0%	
Mean HbA1c	<58 mmol/mol	-	-	-	-	1.3%
	58-79 mmol/mol	1.207085	1.04-1.37	<0.000	2.3%	
	≥80 mmol/mol	2.674783	2.52-2.83	<0.000	10.5%	
Treatment, CGM and HbA1c group interactions	Injections alone and HbA1c <58 mmol/mol	-	-	-	-	1.1%
	Injections alone and HbA1c 58-79 mmol/mol	-	-	-	-	3.4%
	Injections alone and HbA1c ≥80 mmol/mol	-	-	-	-	13.1%
	Injections+rtCGM and HbA1c <58 mmol/mol	-	-	-	-	1.2%
	Injections+rtCGM and HbA1c 58-79 mmol/mol	-0.00894	-0.76-0.74	0.981*		3.9%
	Injections+rtCGM and HbA1c ≥80 mmol/mol	-0.29965	-1.07-0.47	0.443*		11.4%
	Pump alone and HbA1c <58 mmol/mol	-	-	-	-	1.8%
	Pump alone and HbA1c 58-79 mmol/mol	-0.36605	-0.59--0.15	<0.000		4.1%
	Pump alone and HbA1c ≥80 mmol/mol	-0.84521	-1.08--0.61	<0.000		10.2%
	Pump+rtCGM and HbA1c <58 mmol/mol	-	-	-	-	1.1%
	Pump+rtCGM and HbA1c 58-79 mmol/mol	-0.04072	-0.45-0.36	0.844*		3.6%
	Pump+rtCGM and HbA1c ≥80 mmol/mol	-0.70559	-1.32--0.09	0.024*		7.6%
	Constant	-4.90683	-5.12--4.69	<0.000		
Model 2: ordered Logit **Dependent variable: HbA1c groups (ordinal)**						
Age	0-4 years old	-	-	-	-	
	5-9 years old	-0.5588	-0.61--0.5	<0.000		
	10-14 years old	-0.19674	-0.25--0.14	<0.000		

	15-24 years old	0.086772	0.03-0.14	0.002		
Sex	Male	-	-	-	-	
	Female	0.126439	0.1-0.15	<0.000		
Duration of diabetes	<1 year	-	-	-	-	
	1-2 years	0.366731	0.33-0.4	<0.000		
	3-4 years	0.661216	0.62-0.7	<0.000		
	5-9 years	0.858427	0.82-0.89	<0.000		
	10+ years	1.042603	1-1.09	<0.000		
Deprivation	Most deprived	-	-	-	-	
	2nd most deprived	-0.19808	-0.23--0.16	<0.000		
	3rd least deprived	-0.30145	-0.34--0.27	<0.000		
	2nd least deprived	-0.44932	-0.48--0.41	<0.000		
	least deprived	-0.61459	-0.65--0.58	<0.000		

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