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Social and ethnic group differences in healthcare use by children aged 0–14 years: a population-based cohort study in England from 2007 to 2017

Charles Hamish Coughlan, Judith Ruzangi, Francesca K Neale, Behrouz Nezafat Maldonado, Mitch Blair, Alex Bottle, Sonia Saxena, Dougal Hargreaves

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Department of Primary Care and Public Health, Imperial College London School of Public Health, London, UK

Correspondence to
Dr Charles Hamish Coughlan, Department of Primary Care and Public Health, Imperial College London School of Public Health, London W6 8RP, UK; chcoughlan@doctors.org.uk

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ABSTRACT

Objective To describe social and ethnic group differences in children's use of healthcare services in England, from 2007 to 2017.

Design Population-based retrospective cohort study.

Setting/Patients We performed individual-level linkage of electronic health records from general practices and hospitals in England by creating an open cohort linking data from the Clinical Practice Research Datalink and Hospital Episode Statistics. 1 484 455 children aged 0–14 years were assigned to five composite ethnic groups and five ordered groups based on postcode mapped to index of multiple deprivation.

Main outcome measures Age-standardised annual general practitioner (GP) consultation, outpatient attendance, emergency department (ED) visit and emergency and elective hospital admission rates per 1000 child-years.

Results In 2016/2017, children from the most deprived group had fewer GP consultations (1765 vs 1854 per 1000 child-years) and outpatient attendances than children in the least deprived group (705 vs 741 per 1000 child-years). At the end of the study period, children from the most deprived group had more ED visits (447 vs 314 per 1000 child-years) and emergency admissions (100 vs 76 per 1000 child-years) than children from the least deprived group.

In 2016/2017, children from black and Asian ethnic groups had more GP consultations than children from white ethnic groups (1961 and 2397 vs 1824 per 1000 child-years, respectively). However, outpatient attendances were lower in children from black ethnic groups than in children from white ethnic groups (732 vs 809 per 1000 child-years). By 2016/2017, there were no differences in outpatient, ED and in-patient activity between children from white and Asian ethnic groups.

Conclusions Between 2007 and 2017, children living in more deprived areas of England made greater use of emergency services and received less scheduled care than children from affluent neighbourhoods. Children from Asian and black ethnic groups continued to consult GPs more frequently than children from white ethnic groups, though black children had significantly lower outpatient attendance rates than white children across the study period. Our findings suggest substantial levels of unmet need among children living in socioeconomically disadvantaged areas. Further work is needed to determine if healthcare utilisation among children from Asian and black ethnic groups is proportionate to need.

What is already known on this topic?

- Between 2007 and 2017, overall rates of general practitioner (GP) consultation fell across England, while unscheduled care use and outpatient attendances increased substantially.
- These results may mask differences in healthcare use between children from different socioeconomic and ethnic backgrounds.
- There is some evidence of variation in child health outcomes, with worsening infant mortality seen in more deprived areas and certain ethnic groups.

What this study adds?

- This study demonstrates divergent patterns of healthcare use along a social gradient among children living in England.
- While the use of GP and unscheduled care services remains relatively high in Asian children, children from black ethnic groups are less likely to access specialist outpatient care despite rising health needs.
- These results suggest substantial levels of unmet need among children living in more deprived areas.

INTRODUCTION

Child health inequalities are widening in the UK.[1 2] Social gradients exist across various child health conditions, including dental caries,[3] asthma attacks[4] and mental illness.[5] In England, rates of childhood obesity and infant mortality are higher in children from black African Caribbean groups than among their peers.[2] Universal health coverage can mitigate health inequalities and improve population health by reducing the mismatch between clinical need and healthcare use.[6] The UK National Health Service (NHS) provides healthcare free at the point of delivery, and international comparisons suggest it has historically been one of the world's most equitable health systems.[7] A large cross-sectional study conducted in 2002 suggested that self-reported health status, rather than parental socioeconomic status or ethnicity, was the best predictor of healthcare use among British children and young people (CYP).[8] However, there remains a professional,

legal and moral duty to ensure equity of access to services for CYP across income and ethnic groups, particularly in view of recent evidence on rising child poverty levels,[9] and a disproportionate increase in the incidence of adverse child health outcomes among CYP from disadvantaged backgrounds.[10 11] These associations may be mediated by reduced access to or use of health services, emphasising the need to reassess social and ethnic group differences in healthcare use.

When analysing patterns of healthcare use, it is important to consider activity in all settings (online supplemental figure 1). The cradle-to-grave NHS model is centred on general practitioners (GPs), family physicians who provide first contact care to acutely unwell patients, support chronic disease management and act as gatekeepers for onward referral to specialist services.[12] GPs also provide preventive care including childhood vaccinations and development checks. We have previously described changes in children's healthcare use in England between 2007 and 2017.[13] We reported increasing emergency department (ED) and outpatient activity, and decreasing GP consultation rates and in-patient activity among children aged 0–14 years. However, these overall trends may mask differences between CYP from different social and ethnic groups.

In this population-based, retrospective cohort study, we sought to describe differences in healthcare use among children aged 0–14 years and living in England, by healthcare setting, level of deprivation and ethnic group. We hypothesised that children from disadvantaged groups would use less planned and preventive primary and hospital care, resulting in more chaotic disease control, higher rates of acute illness and greater use of emergency services. Our secondary objective was to determine whether between-group differences in healthcare use within our study cohort changed between 2007 and 2017.

METHODS

Study design, data sources and population

We conducted a population-based retrospective cohort study using prospectively collected, longitudinal, patient-level data from the Clinical Practice Research Datalink (CPRD). This includes deidentified data on patient demographics, primary care consultations and secondary care referrals. CPRD is the largest validated primary care research database in the UK, representative for age, sex and ethnicity and encompassing 8% of the UK population.[14]

We linked CPRD to Hospital Episode Statistics (HES), which contains information on NHS hospital activity in England.

Our open cohort included all CYP aged 0–14 years in HES-linked CPRD registered 'up to standard' general practices in England between 1 April 2007 and 31 July 2017. Each child contributed to the time of observation from birth or the date at which they registered at a participating general practice. Children remained in the cohort until they transferred out of practice, reached the age of 15 years, died or reached the end of the study period.

We assigned children to five composite, non-homogenous groups based on ethnic ancestry coding within the CPRD dataset (box 1).

These categories are recommended for use by the UK Office for National Statistics (ONS).[15] Completeness of ethnicity coding within our dataset increased from 74.5% in 2007/8% to 87.8% in 2016/2017. Each participant's postcode was used to allocate them to five ordered groups (most to least deprived) based on the Index of Multiple Deprivation. Index of Multiple Deprivation (IMD) is an official measure of relative deprivation which describes the proportion of children aged 0–15 years living in income-deprived neighbourhoods.[16]

Box 1 Ethnic group composition

White
- English, Welsh, Scottish or Northern Irish.
- Irish.
- Gypsy or Irish traveller.
- Any other White background.

Black
- Black African.
- Black Caribbean.
- Any other Black background.

Asian
- Indian.
- Pakistani.
- Bangladeshi.
- Chinese.
- Any other Asian background.

Mixed
- White and Black Caribbean.
- White and Black African.
- White and Asian.
- Other mixed/multiple ethnic background.

Other
- Arab.
- Any other ethnic group.

Outcomes

Our main outcomes were GP consultations, outpatient attendances, ED visits and emergency and elective in-patient admissions. Practical details of how we used CPRD-HES linked data to derive these outcomes are described in online supplemental file 1.[13] We defined a GP consultation as any face-to-face consultation for illness that took place on practice premises. We excluded routine preventive primary care visits, such as childhood immunisations and child development checks. We defined an outpatient attendance as a recorded consultation between a child and the intended specialist healthcare professional on the date of the appointment on the HES outpatient appointment dataset. We defined an ED visit as an attendance at a consultant-led ED capable of receiving acutely unwell patients, with a 24-hour services and full resuscitation facilities. We excluded visits to consultant-led single-specialty EDs such as walk-in rapid access eye casualty services. We defined an emergency admission as an unplanned admission to hospital based on acute clinical need and an elective admission as a hospital admission where the decision to admit could be separated in time from the admission itself.

Analysis

We calculated annual rates per 1000 child-years for each outcome by dividing the total number of events by the total child-years of observation, directly standardised by age (see online supplemental appendix 1 for more information). We calculated percentage change from baseline for each outcome in each social and ethnic group. We calculated ratios of activity at baseline and in 2016/2017 by dividing the utilisation rate in the most deprived group by that in the least deprived group and dividing the rate for each ethnic group by that among children from white ethnic groups. We used Fieller's theorem to calculate the CIs for the ratios of two means.[17] Due to changes in recording of ED data within the HES dataset, data are not comparable before and after 2010/2011. We used 2011/2012 as

Table 1 Changes in rates of activity by social and ethnic group and healthcare setting

Outcome of interest	IMD group	Baseline rate/1000 child-years	2016/2017 rate/1000 child-years	Percentage change from baseline (95% CI)	Ethnic group	Baseline rate/1000 child-years	2016/2017 rate/1000 Child-years	Percentage change from baseline (95% CI)
GP consultations	1 (least deprived)	2021	1854	−8.3 (−4.1 to −12.4)	White	2113	1824	−13.7 (−11.1 to −16.3)
	2	1987	1817	−8.6 (−4.2 to −12.9)	Black	2404	1961	−18.4 (−7.4 to −29.4)
	3	1999	1826	−8.7 (−4.2 to −13.1)	Asian	2989	2397	−19.8 (−8.9 to −30.7)
	4	2001	1889	−5.6 (−1.3 to −9.9)	Mixed	2343	1951	−16.7 (−3.6 to −29.8)
	5 (most deprived)	1978	1765	−10.8 (−6.7 to −14.8)	Other	1752	1663	−5.1 (2.2 to −12.3)
Outpatient attendances	1 (least deprived)	486	741	52.5 (49.4 to 55.6)	White	641	809	26.2 (23.9 to 28.5)
	2	503	754	49.9 (46.5 to 53.3)	Black	598	732	22.4 (12.7 to 32.1)
	3	499	735	47.3 (43.9 to 50.7)	Asian	720	800	11.1 (2.7 to 19.6)
	4	528	734	39.0 (35.6 to 42.4)	Mixed	688	737	7.1 (−3.6 to 17.8)
	5 (most deprived)	546	705	29.1 (25.8 to 32.4)	Other	325	465	43.1% (40.3 to 45.9)
ED visits	1 (least deprived)	265	314	18.5 (16.2 to 20.7)	White	357	402	12.6 (11.1 to 14.1)
	2	288	340	18.1 (15.5 to 20.6)	Black	405	370	−8.6% (−2.0 to −15.3)
	3	313	373	19.2 (16.5 to 21.8)	Asian	378	390	3.2 (−2.3 to 8.7)
	4	348	408	17.2 (14.5 to 19.9)	Mixed	383	374	−2.4 (−9.8 to 5.1)
	5 (most deprived)	390	447	14.6 (11.9 to 17.4)	Other	191	259	35.6 (31.7 to 39.5)
Emergency admissions	1 (least deprived)	67	76	13.4 (12.1 to 14.8)	White	97	95	−2.1 (−1.1 to −3.1)
	2	70	79	12.9 (11.3 to 14.4)	Black	88	95	8.0 (3.6 to 12.3)
	3	70	89	27.1 (25.5 to 28.8)	Asian	106	106	0.0 (−3.85 to 3.85)
	4	81	96	18.5 (16.9 to 20.2)	Mixed	104	89	−14.4 (−9.5 to −19.4)
	5 (most deprived)	93	100	7.5 (5.9 to 9.2)	Other	39	64	64.1 (61.4 to 66.9)
Elective admissions	1 (least deprived)	42	44	4.8 (3.6 to 5.9)	White	65	55	−15.4 (−14.55 to −16.2)
	2	44	54	22.7 (21.4 to 24.0)	Black	65	62	−4.6 (−0.9 to −8.3)
	3	43	47	9.3 (8.0 to 10.6)	Asian	89	60	−32.6 (−29.4 to −35.7)
	4	49	52	6.1 (4.8 to 7.4)	Mixed	77	85	10.4 (6.3 to 14.5)
	5 (most deprived)	57	57	0.0 (−1.3 to 1.3)	Other	29	36	24.1 (22.0 to 26.3)

Due to improvements in the completeness of ethnicity data during the study period, activity changes by ethnic group should be interpreted with caution.
Baseline year for GP consultations, outpatient attendances, emergency admission and elective admissions—2007/2008.
Baseline year for ED visits—2011/2012.
ED, emergency department; GP, general practitioner.

the baseline year for our analysis of trends in ED activity and 2007/2008 as the baseline year for all other outcomes.

PPI statement

No patients or members of the public were involved in collecting or analysing data for this study, or in the writing or editing of this article.

RESULTS

Overall, 1 484 455 children from 408 GP practices contributed to this cohort study. From 1 April 2007 to 31 March 2017, there were 7 604 024 GP consultations, 981 684 ED visits, 287 719 emergency in-patient hospital admissions, 194 034 elective in-patient hospital admissions and 2 253 533 outpatient visits among children aged 0–14 years in our study population.

Table 1 presents changes in activity in each healthcare setting for children belonging to different social and ethnic groups. Absolute numbers are given for baseline year and 2016/2017 and percentage change from baseline shown for each group. Figure 1 presents trends in children's healthcare use between 2007 and 2017 by setting and social and ethnic group. Table 2 presents ratios of activity in different social and ethnic groups across the study period. Online supplemental tables 1 and 2 show the raw data used to create the graphs in figure 1, for our analyses by IMD and ethnicity, respectively.

Deprivation

In 2016/2017, the most deprived CYP accounted for fewer GP consultations (1765 vs 1854 per 1000 child-years) and outpatient attendances (705 vs 741 per 1000) than the least deprived. In 2007/2008, the most deprived CYP had 2.1% (95% CI 1.7% to 2.6%) fewer consultations than the least deprived. By 2016/2017, this had widened to 4.8% (4.0% to 5.6%). The social gradient for outpatient attendances reversed across the study period. The most deprived CYP had 12.4% (10.9% to 13.8%) more attendances than the least deprived in 2007/2008, but 4.9% (3.3, 6.4%) fewer in 2016/17.

In contrast, the most deprived CYP had more ED visits (447 vs 314 per 1000), emergency admissions (100 vs 76 per 1000) and elective admissions (57 vs 44 per 1000) than the least deprived in 2016/2017. Ratios of activity in these settings were similar at baseline and in 2016/2017.

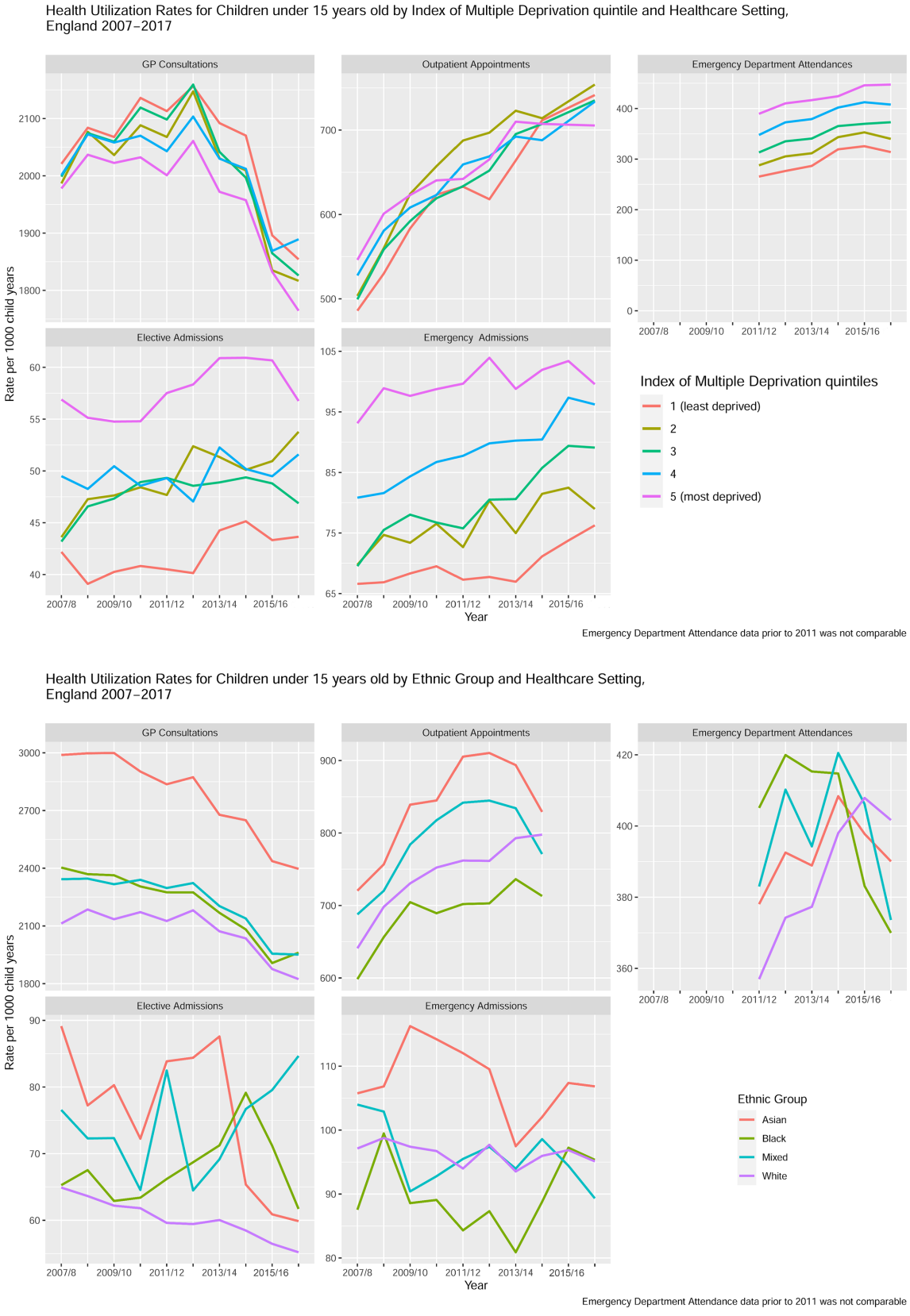

Figure 1 Social and ethnic differences in children's healthcare use graphs. GP, general practitioner.

Ethnicity

In 2016/2017, compared with children from white ethnic groups, black children accounted for more GP consultations (1961 vs 1824 per 1000) and elective admissions (62 vs 55 per 1000). Emergency admission rates were the same in both groups (95 per 1000), but black children had fewer outpatient attendances (732 vs 809 per 1000) and ED visits (370 vs 402 per 1000). Compared with children from white ethnic groups, the ratio of ED activity in those from black ethnic groups reversed from 13.5% (10.6, 16.3) higher to 8% (4.0, 11.9) lower between

Table 2 Ratio of mean utilisation rates by healthcare setting and social and ethnic group

Outcome of interest		Baseline	2016/17
Ratio of mean utilisation rates in children belonging to the most vs least deprived groups			
		Ratio (Lower and Upper 95% CI)	Ratio (Lower and Upper 95% CI)
GP consultations		97.9% (97.4 to 98.3)	95.2% (94.4 to 96.0)
Outpatient attendances		112.4% (110.9 to 113.8)	95.1% (93.6 to 96.7)
ED visits		146.8% (145.1 to 149.3)	142.5% (138.7 to 146.2)
Emergency admissions		139.9% (133.6 to 144.2)	130.6% (123.1 to 140.7)
Elective admissions		134.9% (127.7 to 144.4)	130.1% (119.7 to 140.2)
Ratio of mean utilisation rates in children from black, Asian and mixed ethnic groups vs children from white ethnic groups			
GP consultations	Black	113.8% (112.8 to 114.7)	107.5% (106.2 to 108.8)
	Asian	141.5% (140.5 to 142.4)	131.4% (130.1 to 132.8)
	Mixed	110.9% (109.7 to 112.1)	107.0% (105.5 to 108.5)
Outpatient attendances	Black	93.3% (90.9 to 95.7)	90.5% (87.6 to 93.3)
	Asian	112.3% (110.2 to 114.4)	98.9% (96.3 to 101.4)
	Mixed	107.3 (104.4 to 110.2)	91.1% (88.2 to 94.0)
ED visits	Black	113.5% (110.6 to 116.3)	92.0% (88.1 to 96.0)
	Asian	105.9% (103.6 to 108.2)	97.0% (93.6 to 100.4)
	Mixed	107.3% (104.0 to 110.6)	93.0% (88.8 to 97.3)
Emergency admissions	Black	90.7% (82.5 to 99.0)	100.0% (90.0 to 110.1)
	Asian	109.2% (102.0 to 116.0)	112.4% (102.3 to 121.1)
	Mixed	107.2% (98.0 to 117.0)	93.7% (82.8 to 104.7)
Elective admissions	Black	100.0% (87.8 to 112.3)	112.7% (100.3 to 125.4)
	Asian	136.9% (126.3 to 147.7)	109.1% (98.4 to 120.0(
	Mixed	118.5% (104.2 to 132.9)	154.6% (141.3 to 168.2)

Baseline year for GP consultations, outpatient attendances, emergency admission and elective admissions—2007/2008.
Baseline year for ED visits—2011/2012.
ED, emergency department; GP, general practitioner.

2011/2012 and 2016/2017. In 2007/2008, outpatient activity was 6.7% lower in children from black ethnic groups than in children from white ethnic groups. We observed a similar difference of 9.5% (6.7, 12.4) in 2016/2017.

In 2007/2008, GP consultation rates were 2989 per 1000 in children from Asian ethnic groups and 2113 per 1000 in children from white ethnic groups. Consultation rates fell in both groups across the study period, but remained over 30% higher in children from Asian groups than in white CYP (2397 vs 1824 per 1000) in 2016/2017. At baseline, children from Asian groups had higher ED, outpatient and in-patient activity than white children. These differences were not seen in 2016/2017.

DISCUSSION

In this large population-based retrospective cohort study, we report marked social and ethnic group differences in children's healthcare use in England. During a decade in which child health inequalities widened, use of scheduled and unscheduled care diverged between children living in affluent and deprived postcodes. While outpatient attendance rates were relatively low among children from black ethnic groups across the study period, GP consultation rates remained significantly higher in black and Asian children than among their white peers. By 2016/2017, we found broadly similar overall rates of ED and in-patient activity. Our data suggest that children from black and Asian groups have greater access to primary care services than white children living in England. However, the high rates of adverse child health outcomes in racially minoritised groups indicate that further work is needed to determine whether health service utilisation is proportionate to need.

As described elsewhere,[13] GP consultation rates for all groups significantly outnumbered other forms of healthcare utilisation across the study period. Our study suggests that children living in more affluent areas of England receive more scheduled care in GP practices and specialist clinics, while those from deprived neighbourhoods are more likely to receive unscheduled care. ED visits and hospital admissions are sometimes necessary and appropriate. However, they may result from restricted access to primary care or a failure of successful management in other settings. Previous work has shown that children with greater access to GP appointments in and out-of-hours have significantly lower ED visit rates.[18] The geographical accessibility of English GP practices is similar in affluent and deprived areas.[19] This suggests factors other than proximity also contribute to relatively low use of GP services among CYP from deprived neighbourhoods. GPs in the most deprived areas of England have 15% larger case-loads than GPs working in the most affluent areas.[20] Low parental health literacy is associated with suboptimal preventive care behaviours and inappropriate ED attendances,[21 22] and children living in more deprived areas of England are less likely to engage with preventive care and more likely to require unplanned hospital admission.[23] Few studies have linked parental socioeconomic status, health literacy and child health outcomes, but low health literacy clusters in deprived groups.[24] Work with deprived communities has also highlighted practical barriers to accessing scheduled care. These include difficulties in obtaining appointments in-hours, securing time off work and unacceptable travel costs.[25] With GPs acting as gatekeepers to specialist services, restricted access to primary care may also hinder access to specialist advice. It is concerning that recent studies have highlighted reduced access to tertiary services among children living in deprived areas of England.[26 27]

Proportionate universalism is required to ensure equitable health outcomes for children belonging to different ethnic

groups. Individuals and populations with relatively high health needs require increased access to health services. In 2007/2008, this greater need was reflected in higher GP activity for all ethnic groups and higher outpatient activity in children from Asian and mixed ethnic groups. Previous studies have highlighted similar, high levels of primary care activity among children and adults from Asian ethnic groups living in England.[8 28] While GP activity in all ethnic groups reverted towards levels seen in white groups, it remained relatively high among Asian children. However, it is concerning to see relatively low outpatient activity in children from black ethnic groups. As in adults, much remains to be done to ensure the needs of children belonging to racially minoritised groups are met.[29]

Strengths and limitations

The strengths of this study include its large size, national coverage and representative study population, which reduce the likelihood that our results were due to chance. To our knowledge, this is the largest nationally representative population-based study to assess social and ethnic group trends in children's healthcare use in England across all settings. However, as a sample of the population, our data show wider year-on-year variation for inpatient admissions than previous analysis of national inpatient data.[30] Our analysis did not include data from NHS walk-in centres. NHS 111 services or Child and Adolescent Mental Health services. The composition and volume of missing data in our ethnicity analysis changed over the study period (online supplemental appendix 1). While our 2016/2017 population profile broadly matched 2011 UK census data,[31] trends within each ethnic group should be interpreted with caution due to relatively low representation of racially minoritised groups in our 2007/2008 population. Nonetheless, differing trends in healthcare use across different settings suggest that changes in ethnicity coding completeness alone cannot explain our findings. We used five composite non-homogenous ethnic groups in our analysis, as recommended by the UK ONS to increase consistency and comparability of data. However, we recognise that this is a crude approach which overlooks the complex, self-defined nature of ethnicity and may mask significant within-group differences in socioeconomic and health status, such as those between children from Bangladeshi and Chinese ethnic groups living in the UK. As in other studies using CPRD data,[32] we observed attrition in study population sizes as GP practices transitioned to new electronic patient records. Nonetheless, previous studies have shown very little evidence of systematic bias in the composition of the CPRD population over time.[33] Around 30% of black British children live in economically deprived circumstances, compared with 17% of white British children.[34] As we have not adjusted for deprivation, our findings may underestimate or overestimate the association between ethnicity and children's healthcare use. Finally, IMD provides information on deprivation at neighbourhood level, which may mask household-level variation in parental socioeconomic status in diverse postcodes.

Implications

This study highlights marked social and ethnic inequalities in children's healthcare use in England. Our findings raise concern that the most vulnerable children may be less likely to receive the prevention, health promotion and specialist support which may be most protective against future health problems. Previous work has identified differences in the ability of different health systems to meet children's health needs in an equitable way. For example, one study found that healthcare activity in the Netherlands was well-matched to need, whereas children living in low-income households in the USA experienced a double burden of worse health and less contact with services.[35] It is concerning that patterns of children's healthcare use in England appear closer to those seen in the USA, despite the NHS offering healthcare free at the point of delivery. While context and effective interventions will vary across areas and communities, a combination of the approaches outlined in box 2 could help to deliver more equitable services in England.

CONCLUSION

This study identifies divergent patterns of healthcare use along a social gradient among children aged 0–14 years in England. Children living in more deprived areas have higher ED and in-patient activity, while affluent groups have higher rates of GP and outpatient consultation. Across the study period, outpatient

Box 2 Policy and practice interventions to reduce social and ethnic inequalities in children's healthcare

Education and training for patients, families and professionals

There is evidence that some health professionals lack confidence and experience in supporting patients from minoritised groups.[36] Training in cultural competence has been well received by child health professionals and could help to address this skills gap.[37 38] A universal teaching programme which provides school-age children and new parents with information on their rights and responsibilities, available services and entitlements could also improve health literacy and support self-care.

Integrated community child health and health literacy

Community health interventions have been found to reduce inequity in health outcomes in low-income and middle-income settings,[39] Evidence-based decision support tools and in-person navigation interventions can encourage appropriate child healthcare utilisation.[40] GP consultations significantly outnumber other forms of clinical consultation between children and healthcare professionals. Integration of care around GP services therefore constitutes a logical means of addressing inequalities in healthcare utilisation. Integrated services have the potential to mitigate and prevent health inequalities, through timely recognition and management of new health problems, coordination and continuity of care and health promotion interventions.[41] Future research on Integrated Care Systems within the English NHS must assess their impact on health inequalities in children and young people.

Community engagement in health service development, staffing and research

Sustainable engagement of disadvantaged and racially minoritised communities in health service development and improvement is essential if we are to address inequalities in the long term.[42] Engaging community groups that are representative of diverse local populations helps to create user-friendly services and address the underlying reasons for poor health.[43] Similarly, involving members of racially minoritised and disadvantaged social groups in a participatory research process is likely to help us better understand the reasons for specific differences in healthcare use between ethnic groups.[44] Efforts to increase representation of health professionals from racially minoritised groups may increase the availability of culturally congruent care,[45] which has been linked to striking improvements in infant mortality among children from black groups in the USA.[46]

activity was lower in children from black ethnic groups than in those from White and Asian groups. GP consultations remained higher in children from black and Asian groups than in white children, and by 2016/2017, outpatient, ED and in-patient activity were similar in children from white and Asian groups. While these data indicate that children from different ethnic groups have relatively equal access to health services in England, the disproportionately high rates of adverse child health outcomes in racially minoritised groups suggest an urgent need for further work to determine whether health service utilisation is proportionate to need. Considered alongside rising child poverty and widening child health inequalities, our findings suggest significant levels of unmet need among CYP living in more deprived areas of England.

Twitter Sonia Saxena @SoniaKSaxena

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Disclaimer We are unable to directly share results with participants or their caregivers as this study used deidentified patient data. However, the results of this study will be disseminated to the public through press releases, social media postings and media commentary.

Competing interests DH is Deputy Chief Scientific Advisor to the Department for Education

Patient consent for publication Not required.

Ethics approval The Independent Scientific Advisory Committee granted ethical and scientific approval for the use of CPRD in our study. Protocol number: 18_139.

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Data availability statement No data are available. Due to data sharing agreements, data are unavailable for sharing publicly. Data may be obtained from a third party (the Clinical Practice Research Datalink) and are not publicly available.

ORCID iDs
Charles Hamish Coughlan http://orcid.org/0000-0003-3907-3859
Behrouz Nezafat Maldonado http://orcid.org/0000-0002-7488-5564
Sonia Saxena http://orcid.org/0000-0003-3787-2083

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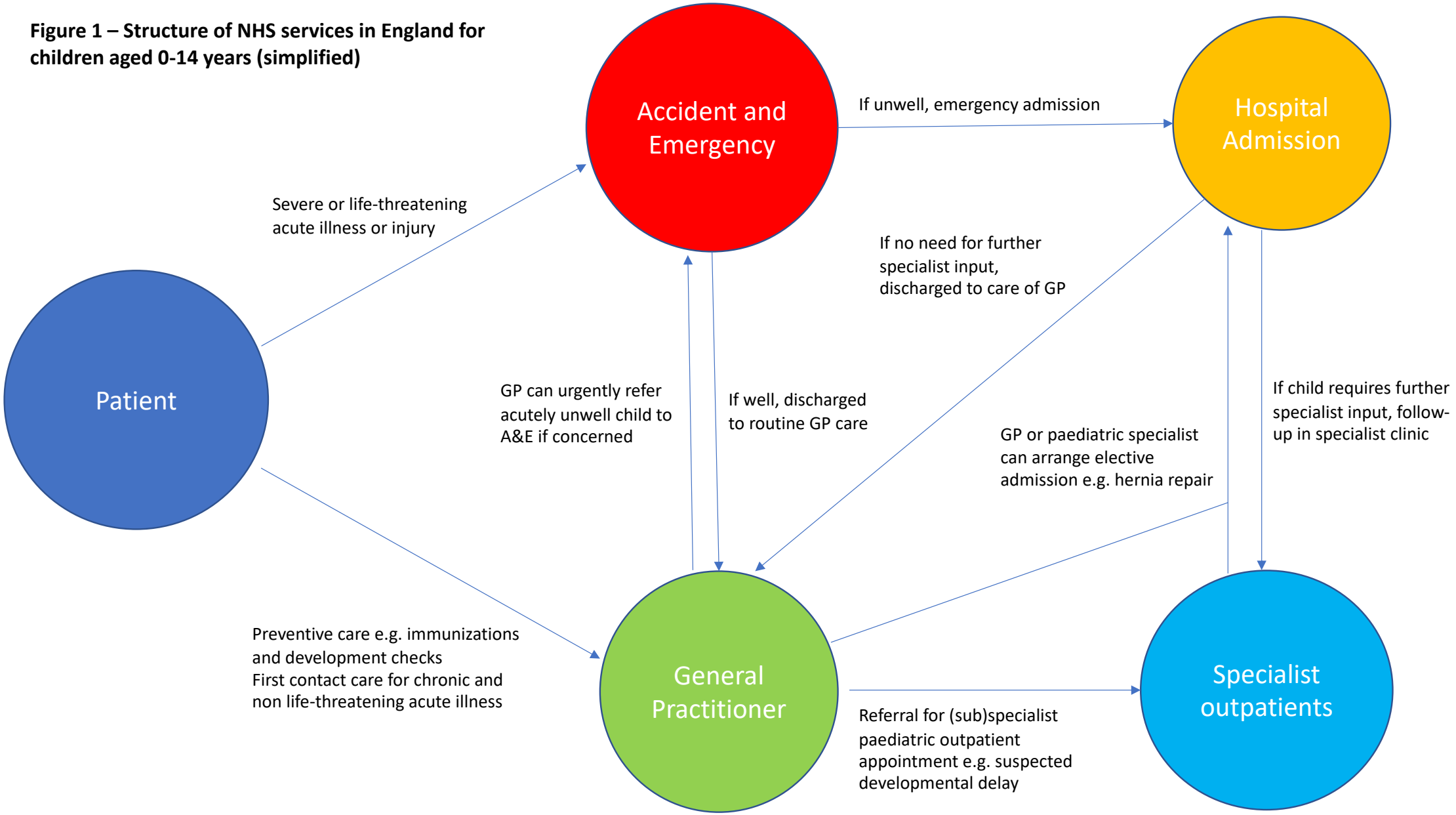
Figure 1 – Structure of NHS services in England for children aged 0-14 years (simplified)



Appendix 1 – Coughlan et al, 2020

Age-standardization

Activity rates in each healthcare setting were age-standardized for each social and ethnic group by comparison to the 2016 mid-year English population estimate. We used the proportions in the table below to calculate these figures.

Age Group	Population	Proportion of total study population
0-1 year	669,103	0.0673985
1-4 years	2,759,943	0.278008
5-9 years	3,428,266	0.3453279
10-14 years	3,070,254	0.3092655
Total	9,927,566	1

Missing Data

Only a small portion of data were missing for our analysis by level of deprivation (accounting for 0.5% of study sample in 2007/8 and 2.2% in 2016/17). These data are summarised for the years 2007 and 2016/17 in the table below.

IMD Group	2007/8	Percentage total study population	2016/17	Percentage total study population
1 (least deprived)	119952	22.9	63017	23.8
2	106334	20.3	48034	18.1
3	103818	19.8	47562	18.0
4	96133	18.3	51103	19.3
5 (most deprived)	96061	18.3	49313	18.6
Missing	2633	**0.5**	5926	**2.2**
Total	524931	100	264955	100

The table below presents ethnicity data, including missing data, with reference to official statistics on membership of different ethnic groups by sex and age, as held by the UK Office for National Statistics (ONS). These data are freely available at: https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/ethnicity/adhocs/009102ethnicitybysexandagesinenglandandwales2011to2015

Ethnicity Allocation	2007	Percentage total study population	2016	Percentage total study population	ONS estimate – percentage total population of England for CYP aged 0-14 years
White	315629	60.1	181452	68.5	77.8
Black	9543	1.8	10000	3.8	4.2
Asian	17035	3.2	15257	5.8	9.6
Mixed	8414	1.6	9845	3.7	5.4
Other	41992	8.0	16013	6.0	2.9
Missing	132318	25.5	32388	12.2	N/A
Total	524931	100	264955	100	100

Appendix 1 – Coughlan et al, 2020

The completeness of our ethnicity dataset increased from almost 75% in 2007/8 to 87.8% in 2016/17. The significant attrition in the size of our study population – for both IMD and ethnic group analyses – over the study period has been described in other studies employing CPRD data (see manuscript, reference 36) and reflects the transition of GP practices to new electronic patient records.

Supplemental Table 1 – Raw Data for IMD Analyses in Figure 1

GP CONSULTATIONS							ED VISITS	NB We used 2011-12 as baseline year for comparisons of ED data due to changes in data completeness						
	Least deprived				Most deprived			Least deprived				Most deprived		
	1	2	3	4	5			1	2	3	4	5		
2007/8	2020.906658	1986.78685	1998.5847	2001.13232	1977.958259		2007/8	0.219974345	0.42177621	0.68353602	0.62816366	0.964791821		
2008/9	2083.916321	2076.86052	2074.57405	2072.44018	2036.834453		2008/9	96.03570518	89.7043556	100.365338	108.763323	139.8467973		
2009/10	2067.76618	2036.28427	2059.62544	2058.13732	2022.502783		2009/10	176.5255805	171.052278	184.506859	211.558809	276.0709551		
2010/11	2135.956515	2088.25814	2119.07189	2069.97275	2032.239414		2010/11	230.3544409	241.558726	260.561827	290.680028	345.1796002		
2011/12	2112.940746	2067.84915	2098.29506	2043.00452	2001.012099		2011/12	265.4393028	287.722538	313.231041	347.727596	389.60124		
2012/13	2156.402907	2147.32742	2159.27358	2103.46714	2060.839756		2012/13	276.4607509	305.341579	335.162245	372.702636	410.1886235		
2013/14	2092.038759	2030.42338	2041.7811	2029.96102	1972.102271		2013/14	286.4601992	311.539774	340.607129	379.129487	416.628945		
2014/15	2070.218569	2009.51177	1996.80423	2012.19363	1957.462798		2014/15	319.2872382	343.357742	365.309381	401.916609	424.2971376		
2015/16	1896.098845	1835.04768	1864.85645	1868.93031	1832.415926		2015/16	325.5003425	352.865718	369.756595	412.469554	445.9286063		
2016/17	1854.238023	1816.73159	1826.02218	1889.20102	1764.62117		2016/17	313.8882222	340.027193	372.899552	407.834847	447.3673949		
EMERGENCY ADMISSIONS							ELECTIVE ADMISSIONS							
	Least deprived				Most deprived			Least deprived				Most deprived		
	1	2	3	4	5			1	2	3	4	5		
2007/8	66.5963756	69.7520964	69.5329861	80.8323263	93.13464336		2007/8	42.17836441	43.6062968	43.1866922	49.4947903	56.89036974		
2008/9	66.86101224	74.6873623	75.5036447	81.5968329	98.91059356		2008/9	39.09667128	47.2721679	46.5732804	48.2618254	55.13378548		
2009/10	68.31707689	73.3867291	78.0281774	84.3441549	97.65048025		2009/10	40.25280575	47.6340218	47.3316465	50.4547645	54.7614211		
2010/11	69.50016377	76.5223088	76.7307456	86.7218517	98.76008243		2010/11	40.82102171	48.4245082	48.9215903	48.5657219	54.79183408		
2011/12	67.28731191	72.668319	75.7658031	87.747235	99.66290488		2011/12	40.50228417	47.6810501	49.3302415	49.3118991	57.51895436		
2012/13	67.73659834	80.3539408	80.5089259	89.8059186	103.9399916		2012/13	40.13689188	52.3827941	48.5627702	47.0490519	58.34777041		
2013/14	66.95124379	74.9844011	80.6037669	90.2601123	98.80534005		2013/14	44.25401137	51.3411848	48.8942886	52.2671656	60.89149607		
2014/15	71.13356691	81.4651187	85.7468749	90.4384365	101.9500345		2014/15	45.1394241	50.1061612	49.3783807	50.1869281	60.92362395		
2015/16	73.7596091	82.482497	89.3966685	97.345974	103.4024654		2015/16	43.32094856	50.9451157	48.794331	49.4877456	60.67060775		
2016/17	76.26210179	78.9711138	89.1051917	96.2367394	99.58342927		2016/17	43.64361421	53.7746771	46.8781952	51.5932657	56.75977544		
OUTPATIENT ATTENDANCES	NB 2015 data are of poor quality and therefore excluded						Rates for all tables are given per 1000 child-years							
	Least deprived				Most deprived									
	1	2	3	4	5									
2007/8	485.9811164	503.491136	499.437933	527.729573	546.1865713									
2008/9	529.864209	559.955545	558.462329	580.707106	600.8722171									
2009/10	583.3823689	624.243622	592.082576	608.230654	622.9836711									
2010/11	623.4202026	657.131988	619.18575	623.06209	640.3772432									
2011/12	632.9207162	687.628616	633.499326	659.270846	642.0853058									
2012/13	618.0320999	696.93001	652.055689	668.82826	665.2384159									
2013/14	663.9566771	722.933442	695.275583	692.315339	709.9599346									
2014/15	711.4948321	714.047951	707.264341	687.984328	707.3169953									
2015/16	EXCLUDE	EXCLUDE	EXCLUDE	EXCLUDE	EXCLUDE									
2016/17	741.48605	753.922382	735.149153	733.71515	705.4444327									

Supplemental Table 2 – Raw data for rates of healthcare utilization by setting and ethnic group

GP CONSULTATIONS

	White	Black	Asian	Mixed	Other
2007	2112.777	2403.5848	2988.87272	2342.8824	1752.5243
2008	2185.584	2369.2728	2997.52539	2345.9378	1765.6721
2009	2134.975	2363.4656	2999.05123	2316.9108	1748.6148
2010	2171.743	2305.3134	2902.75102	2339.7897	1747.0475
2011	2125.773	2274.869	2836.51199	2297.1148	1752.4552
2012	2181.272	2274.6588	2873.01998	2322.9731	1775.1606
2013	2072.09	2168.3908	2677.89651	2203.4587	1733.8731
2014	2035.422	2081.6911	2649.49643	2138.8077	1714.888
2015	1876.142	1907.1009	2436.97024	1955.7985	1612.5118
2016	1823.542	1961.0535	2396.89059	1951.2099	1662.5251

ED VISITS

	White	Black	Asian	Mixed	Other
2007	0.806345895	0	0.127555219	0	0.242401059
2008	120.5168541	159.3909901	135.0353681	144.855733	73.65174922
2009	230.6980849	270.307591	232.1291481	265.0866242	128.0882651
2010	304.2966959	368.955777	336.1990139	337.9342663	168.8161411
2011	356.9751935	405.0900531	378.0538135	383.0098133	191.2189502
2012	374.2368317	419.9465568	392.5400698	410.2271599	208.7491789
2013	377.3016081	415.3187669	388.8941668	394.2770768	227.8725085
2014	398.0063939	414.7445132	408.3671587	420.5112223	236.8780304
2015	407.8865529	383.1361997	397.7792121	406.1627598	255.8533893
2016	401.6633606	369.9826168	390.0688857	373.5965599	258.4713237

EMERGENCY ADMISSIONS

	White	Black	Asian	Mixed	Other
2007	97.12845	87.54143	105.7539	103.9882	38.96787
2008	98.76989	99.47611	106.8349	102.8994	39.10239
2009	97.40095	88.57699	116.2626	90.4131	38.73675
2010	96.72639	89.07146	114.2125	92.78374	39.53646
2011	93.99346	84.31535	112.035	95.49133	42.54894
2012	97.70335	87.31394	109.5237	97.3928	40.43785
2013	93.52571	80.88984	97.47871	93.96954	45.73218
2014	95.96572	88.77726	102.0314	98.58739	48.96275
2015	96.86989	97.24228	107.371	94.42474	59.08668
2016	95.10802	95.35245	106.8393	89.32831	64.32755

ELECTIVE ADMISSIONS

	White	Black	Asian	Mixed	Other
2007	64.91204866	65.27470684	89.13355414	76.55479026	28.55411533
2008	63.63705892	67.52367284	77.23284028	72.29138665	26.24435087
2009	62.19859407	62.89857088	80.27749621	72.32072476	26.01135371
2010	61.81228846	63.39365973	72.24664397	64.55056106	19.80923462
2011	59.60520835	66.19732716	83.85458064	82.47457677	27.16454038
2012	59.43557622	68.70679375	84.38948642	64.47472882	23.74952901
2013	60.03514588	71.23687149	87.58266331	69.15324706	25.38167775
2014	58.46822213	79.13229599	65.369485	76.69325921	29.69872106
2015	56.47009474	71.18453411	60.89189874	79.54917228	29.07527942
2016	55.19931497	61.70606848	59.87266406	84.65828946	36.22531824

OUTPATIENT ATTENDANCES

NB 2015 data are of poor quality and therefore excluded

	White	Black	Asian	Mixed	Other
2007	640.9623981	598.4047373	720.4504959	687.7004581	325.9393763
2008	698.1540687	656.3556329	756.7130751	720.2939441	334.8067149
2009	730.5182252	704.6112266	839.0859761	784.0932423	328.0777532
2010	752.3384818	689.3393772	844.9169729	817.6025037	307.6042845
2011	762.0283982	701.9738853	905.3473857	841.8670558	324.0329639
2012	761.5426007	702.9226963	910.4005449	844.714608	301.7793855
2013	792.911721	736.3178362	893.7090678	834.2172641	348.2449438
2014	797.7563415	713.1079669	829.1758359	770.9924988	348.2470573
2015	EXCLUDE	EXCLUDE	EXCLUDE	EXCLUDE	EXCLUDE
2016	808.8978508	731.5650067	800.9896066	736.8122338	464.6916383