

# Retrospective analysis of North West London healthcare utilisation by children during the COVID-19 pandemic

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## ABSTRACT

**Objective** To explore the impact of the measures taken to combat COVID-19 on the patterns of acute illness in children presenting to primary and secondary care for North West London.

**Design/setting/participants** Retrospective analysis of 8 309 358 primary and secondary healthcare episodes of children <16 years registered with a North West London primary care practice between 2015 and 2021.

**Main outcome measures** Numbers of primary care consultations, emergency department (ED) attendances and emergency admissions during the pandemic were compared with those in the preceding 5 years. Trends were examined by age and for International Statistical Classification of Diseases and Related Health Problems 10th Revision-coded diagnoses of: infectious diseases, and injuries and poisonings for admitted children.

**Results** Comparing 2020 to the 2015–2019 mean, primary care consultations were 22% lower, ED attendances were 38% lower and admissions 35% lower. Following the first national lockdown in April 2020, primary care consultations were 39% lower compared with the April 2015–2019 mean, ED attendances were 72% lower and unscheduled hospital admissions were 63% lower. Admissions >48 hours were on average 13% lower overall during 2020, and 36% lower during April 2020. The reduction in admissions for infections (61% lower than 2015–2019 mean) between April and August 2020 was greater than for injuries (31% lower).

**Conclusion** The COVID-19 pandemic was associated with an overall reduction in childhood illness presentations to health services in North West London, most prominent during periods of national lockdown, and with a greater impact on infections than injuries. These reductions demonstrate the impact on children of measures taken to combat COVID-19 across the health system.

## INTRODUCTION

In London, between January 2020 and 12 July 2021, there were 801 718 confirmed cases of infection with SARS-CoV-2, 74 612 SARS-CoV-2 positive patients admitted to hospital and 19 265 deaths with COVID-19 listed as a cause on the death certificate.<sup>1</sup> To prevent hospitals from being overwhelmed and to protect key workers and vulnerable people, a number of coronavirus restrictions were put

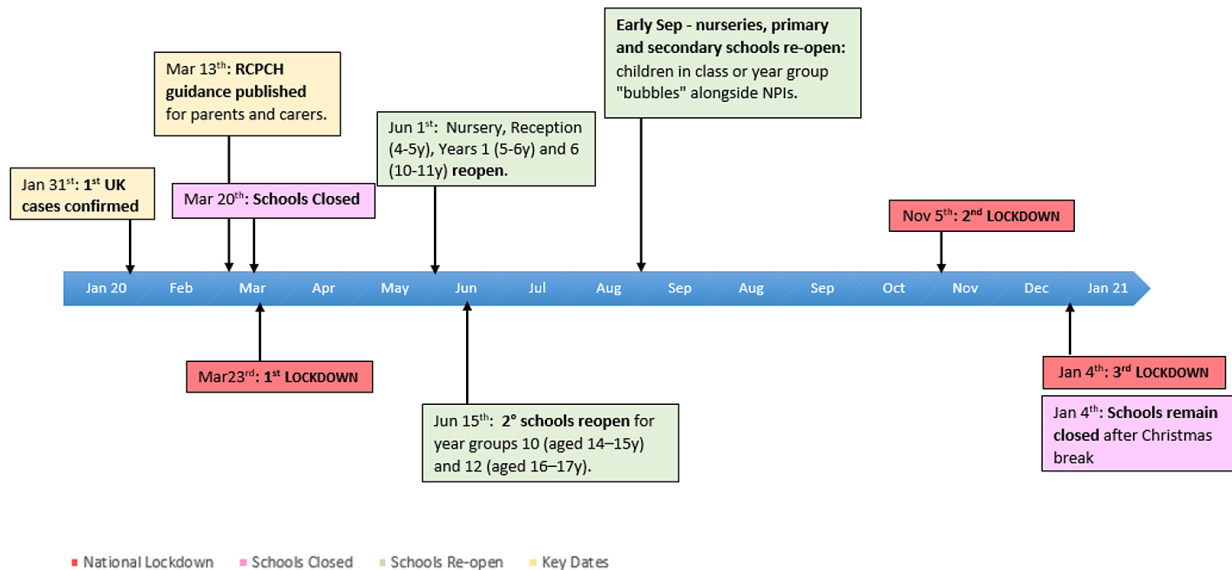
## What is known about the subject?

- ▶ Healthcare usage declined as a response to social distancing measures taken to combat the COVID-19 pandemic.
- ▶ Non-COVID-19 infections may have declined due to these same measures.
- ▶ Public Health England and clinicians were concerned about delayed care seeking for serious paediatric conditions, and a disproportionate increase in admissions for serious illness.

## What this study adds?

- ▶ The number of paediatric consultations reduced in both primary and secondary care during the first year of the COVID-19 pandemic.
- ▶ The proportion of consultations taking place in primary care changed very little from prepandemic levels.
- ▶ Monthly hospital admissions for infections (excluding COVID-19) and injury were substantially lower than expected across the first lockdown in 2020, and there was no overall increase in admissions lasting 48 hours or more.

in place by the government ([figure 1](#)).<sup>2</sup> While the vast majority of SARS-CoV-2 infections in children are asymptomatic or mild, children were also subject to coronavirus restrictions. Changes in healthcare consultations for acute childhood illness associated with these restrictions have been examined in several studies.<sup>3–8</sup> At the start of lockdown, primary care consultations dropped by 30% in a sample of 84 practices across England, and routine referrals were 74% lower.<sup>9</sup> In England, emergency departments (ED) attendances decreased across all ages with the largest reduction (65% fall) seen in children aged 5–14 years.<sup>10</sup> In Scotland, emergency medical paediatric admissions reduced by almost 50% but surgical admissions did not decrease.<sup>11</sup> As no studies in children have assessed primary and



**Figure 1** Timeline of COVID-19-related events in England during the study period. Ages for each year group are given in brackets. The first national ‘lockdown’ was announced on 23 March 2020.<sup>38</sup> A second month-long lockdown was implemented on 5 November 2020 in response to a surge in cases and rising reproduction number, followed by a third lockdown on 4 January 2021, primarily to combat a new variant of the virus. Schools were initially closed on 18 March 2020, excepting the children of keyworkers and those with special educational needs and disabilities. Classes for reception, year 1 (aged 5 or 6 years) and year 6 (aged 10 or 11 years) pupils were reopened on June first with some secondary school pupils returning on 15 June until the end of the summer terms in mid-late July. Schools, colleges and nurseries were opened to all children for the start of the new school year in September 2020. Schools were asked to keep children in class or year-group ‘bubbles’ alongside non-pharmaceutical interventions that included regular cleaning, handwashing and testing.<sup>39</sup> Schools closed for the Christmas break around 17 December 2020 and plans to return to school were aborted when England entered a third national lockdown on 6 January 2021. RCPCH, Royal College of Paediatrics and Child Health

secondary care as a whole, we cannot determine whether apparent changes in consultations reflect redistribution of consultations between primary and secondary care, or whether delays in presentation or true reductions in acute childhood illness occurred.

The Whole Systems Integrated Care (WSIC) database for North West London (NWL) provides linked primary and secondary care electronic patient records for 2.3 million general practice (GP)-registered patients across the eight Clinical Commissioning Groups spanning the region, representing 95% of the NWL population and including 547 542 children.<sup>12</sup> Patients may opt out if they only want their records to be used for direct care. Records of primary care consultations and ED visits cover most acute healthcare-seeking episodes in this population and allow changes in healthcare utilisation to be tracked over time. We used the WSIC database to assess the impact of the COVID-19 pandemic and associated lockdown measures on children under 16 years presenting to primary and secondary care across NWL.

## METHODS

### Study design and data source

This was a retrospective observational study using the WSIC database in NWL. The target population was patients under the age of 16 registered with a GP practice in NWL between 1 January 2015 and 5 February 2021.

Anonymised data from children was used in the study until they turned 16; the child died (date of deregistration from their GP); they ceased their registration with an NWL GP; or the study period ended. Contributing primary care practices provide appointment details and WSIC is also linked to Secondary User Services (SUS) data providing secondary care utilisation records for the NHS hospitals in the same area.<sup>12</sup> The COVID-19 NWL Data Prioritisation Group approved this study on 7 August 2020 permitting access to the deidentified data set. Dates of the national lockdowns and changes to the school year during the study period are summarised in figure 1.

### Healthcare utilisation

First, four categories of healthcare utilisation were defined spanning the care pathways for the study period: (1) primary care appointments, defined as consultations in one of the participating GP practices: these were extracted from WSIC data environment on the 3 March 2021, and included both face-to-face and virtual consultations; (2) ED attendances: these were obtained through WSIC’s linkage to SUS Accident and Emergency data, were extracted on 25 February 2021 and (3) inpatient admissions: WSIC’s linkage of SUS admitted patient care records provided data for emergency (or unscheduled) inpatient admissions corresponding to a unique inpatient spell. An inpatient spell covers the total duration of

an admission even if this includes a transfer to a different department or another inpatient healthcare facility. Stays with missing start or end dates were excluded. Admissions to any level of care neonatal unit were excluded and these were identified where child age on admission was unavailable but the variables: 'neonatal level of care' and 'treatment function code' (corresponding to midwifery, neonatology or well babies) was recorded using SUS data records. Elective admissions were not included in this analysis; (4) Admissions lasting over 48 hours, or resulting in a death within hospital at any stage, were used as a proxy for severe illness. This category was considered as including paediatric intensive care unit (PICU) admissions: 2 days was the median duration in a study of eight US PICUs before returning to the ward.<sup>13</sup> All hospital activities, including ED attendances and unscheduled inpatient admission were defined as secondary care for the purposes of this study. In order to understand how patients accessed healthcare, we examined the relative proportions of primary care and ED consultations for each month in 2020 compared with the 5-year average.

Second, two diagnostic groups were selected from the secondary care admissions cohort using their codes listed in the corresponding chapters from the WHO International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10).<sup>14</sup> The infectious and parasitic diseases category (chapter I) contained respiratory infection codes but COVID-19 (U07.1) was omitted. Chapter XIX is defined by inclusion of injury, poisoning and certain other consequences of external causes.

### Analysis

Data analysis was conducted using R V.4.0.2. Each cohort was arranged into counts per month for 1 January 2015 to 31 January 2021. Using counts provided absolute event numbers for each month, or 5-year mean of each month, allowing direct comparison to primary and secondary care consultations and attendances. ED, inpatient and severe admission datasets were subdivided into five age bands: 0–1; >1–2; >2–5; >5–11 and >11–16 years. The

inpatient and severe admission cohorts were stratified by each of the two diagnostic groups. Counts for the period January 2020 to January 2021 were compared with the 5-year mean with 95% CIs of the corresponding month for the years 2015–2019. If the value during the study period was found to be outside of the 95% CI of the 5-year mean, then this difference was quantified by the percentage difference between the count and 5-year mean.

### RESULTS

Between 1 January 2015 and 31 January 2021, there were 7 306 887 primary care appointments and 1 002 471 ED attendances for children aged under 16 years. A total of 4 248 575 (51%) episodes were for male children. A total of 92 607 (9%) of ED attendances resulted in admission to hospital of ≤48 hours and 13 101 (1%) of these ED attendances were admitted for >48 hours. One-third of unscheduled hospital admissions of any duration were diagnosed as infections (35 084; 33%) (table 1).

### Presentations

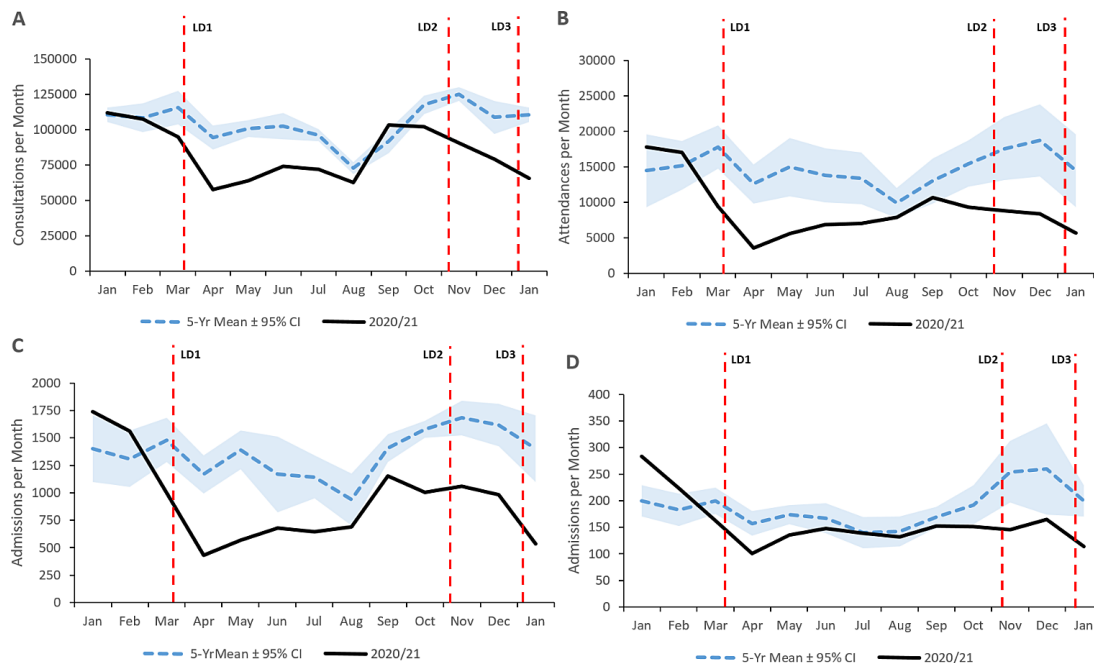
Each lockdown was associated with lower than expected numbers of presentations and admissions (figure 2A–C). The lowest consultation and admission counts occurred during the first national lockdown in April 2020 with 39% fewer primary care consultations compared with the mean in 2015–2019 (table 2): consultations dropped from a mean of 94 379–57 769 during this single month. There were also 72% (9039) fewer ED attendances and 63% (737) fewer admissions to hospital. The reduction was smaller in patients admitted >48 hours: 36% (56) fewer admissions (figure 2D). Fewer presentations and admissions were observed during the second and third lockdowns as well, although the declines in presentations and inpatient admissions were less severe during second lockdown period compared with the first and third lockdown periods.

Primary care, ED attendances and inpatient admissions returned close to expected levels by August 2020 when

**Table 1** Summary of numbers of ED attendances and hospital admissions from January 2015 to January 2021, stratified by age and diagnosis group

	ED (n=1 002 471)	Inpatient (n=92 607)	>48 hours (n=13 101)
<b>Age group</b>			
0–1	222 230 (22%)	25 764 (28%)	4303 (33%)
>1–2	112 511 (11%)	11 367 (12%)	1198 (9%)
>2–5	227 791 (23%)	20 684 (22%)	2193 (17%)
>5–11	267 357 (27%)	20 182 (22%)	2730 (21%)
>11–16	172 582 (17%)	14 610 (16%)	2677 (20%)
<b>Diagnosis group</b>			
Infection		29 538 (32%)	5546 (42%)
Injury		15 347 (17%)	2257 (17%)

ED, emergency department.



**Figure 2** Comparisons of healthcare presentations for each month of 2020/2021 with mean from the corresponding month of 2015–2019. The shaded area illustrates the 95% CI for 2015–2019. LD—start date of period of national lockdown. (A) Primary care consultation. (B) ED attendances. (C) Emergency inpatient admissions. (D) Admissions lasting >48 hours. ED, emergency department.

some restriction measures were relaxed. Admissions >48 hours returned to seasonal average levels by June 2020.

The observed trends were consistent across different age-groups (online supplemental figure 1). ED visits were most reduced for the >5–11 years (73% lower) and >11–16 years (77% lower) groups in April 2020; the former group remaining below average through the end of the year. Notably, inpatient admission reductions were seen in all age groups with the greatest percentage reductions in April and May 2020 in the 0–1 year (63%), >1–2 years (73% in May) and >2–5 years (73%) groups. Only the >11–16 years age group exceeded the 5-year average admissions at any time during 2020 (in August 2020). In the >5–11 years old group, patients admitted for more than 48 hours returned to expected levels by May, while in the >11–16 years old group, there were higher than expected case numbers between July and September 2020, when schools were mostly closed to pupils not taking exams (online supplemental figure 1).

Before 2020, the ratio of primary care: ED visits was 90:10, while in 2020 it was 88:12 (online supplemental figure 2). In April 2020, after implementation of the first national lockdown, 93% of consultations were in primary care, compared with the 5-year average for April of 88%.

### Reasons for hospital admission

We examined unscheduled admissions for the two of the most common categories of illness: infection and injury. These categories together made up 44 485 (48%) of admissions lasting  $\leq$ 48 hours, and 7803 (60%) of admissions lasting >48 hours, over the course of the study.

For all ages combined (online supplemental figure 3AB, online supplemental table 1), infections accounted for an average of 514 admissions per month during 2015–2019. Between April and August 2020, cases of infection were an average of 61.2% (225 cases per month) lower than the 5-year mean among inpatient admissions, and 23.3% (16 cases per month) lower for severe admissions (online supplemental table 1). Stratifying by age group (online supplemental figure 4), the greatest decline in admissions was seen in >1–2 years old, with a 74% (48 admissions) reduction each month.

Over the same period, injuries and poisoning admissions fell by an average 21% (50 admissions per month) between April and August 2020. However, there was little change in admissions over 48 hours: an average of 31 cases per month between April and August 2020 vs 32 cases per month for the 5-year average over the same period (online supplemental table 1). Schoolchildren were most affected when schools were first closed: between March and June 2020, inpatient admissions in >5–11 years old were lower by a monthly average of 39% (28 admissions per month) and >11–16 dropped by an average of 31% (24 admissions per month) (online supplemental figure 4).

### DISCUSSION

Children have been relatively spared from the direct health impacts of the COVID-19 pandemic, but there has been significant concern about the indirect effects on their health and well-being.<sup>15</sup> A drop in primary and

**Table 2** Table of changes in healthcare presentations for each month of 2020/2021 compared with mean from the corresponding month of 2015–2019

Month	Primary	ED	Inpatient	>48 hours admission
January 2020	1448 (+1%)	3315 (+23%)	335 (+24%)	84 (+42%)
February	-789 (-1%)	1817 (+12%)	253 (+19%)	40 (+22%)
March	-20 892 (-18%)	-8428 (-47%)	-484 (-33%)	-38 (-19%)
April LD1	-36 610 (-39%)	-9039 (-72%)	-737 (-63%)	-56 (-36%)
May	-36,783 (-37%)	-9,360 (-62%)	-822 (-59%)	-39 (-22%)
June	-28 316 (-28%)	-6929 (-50%)	-489 (-42%)	-19 (-11%)
July	-24 042 (-25%)	-6343 (-47%)	-501 (-44%)	-1 (-1%)
August	-10 301 (-14%)	-2033 (-21%)	-247 (-26%)	-10 (-7%)
September	11 421 (+12%)	-2313 (-18%)	-252 (-18%)	-17 (-10%)
October	-15 561 (-13%)	-6124 (-40%)	-573 (-36%)	-41 (-22%)
November LD2	-34 430 (-28%)	-8761 (-50%)	-624 (-37%)	-108 (-43%)
December	-29 527 (-27%)	-10 322 (-55%)	-637 (-39%)	-95 (-36%)
January 2021 LD3	-45 026 (-41%)	-8765 (-61%)	-867 (-62%)	-86 (-43%)

LD—start of period of national lockdown.

Changes in counts and the percentage change in primary care presentations, ED visits and emergency inpatient admissions longer than 48 hours are shown

ED, emergency department.

secondary care attendances at the start of lockdown, and reports of delayed presentation of serious illness, prompted the National Health Service and The Royal College of Paediatrics and Child Health to remind patients to seek medical care when required.<sup>16–18</sup> Therefore, it is important to use large-scale data to quantify the impact of the pandemic and the periods of national lockdown on the presentations of children to healthcare providers. By analysing integrated primary and secondary care data on children across NWL from January 2015 to January 2021 we were able to identify changes in patterns of presentation and utilisation of healthcare and changes in severity of illness.

We found that primary care consultations, ED attendances and emergency hospital admissions were substantially below 5-year averages during periods of lockdown. The proportion of consultations taking place in primary care changed very little from pre-pandemic

levels. Attendances due to infections fell the most during lockdowns, while injuries and poisonings were lowest in schoolchildren (5–16 years) when schools were shut between March and June 2020.

Numbers of admissions >48 hours decreased to a lesser extent. This is consistent with a study of 23 paediatric EDs in North-Western Italy: low priority admissions decreased almost twice as much as critical presentations. The authors suggested that non-pharmaceutical interventions (NPIs) and fear of infection lowered non-urgent use of ED facilities but that this reticence was overcome by recognition of children with urgent symptoms, especially in those with significant comorbidities.<sup>19</sup> The higher than expected admissions >48 hours observed in the >11–16 years group between July and September 2020 may be partly explained by the pandemic's impact on mental health.<sup>20</sup> Increases have been recorded in behavioural and attentional difficulties, eating disorders, depression

and anxiety.<sup>21 22</sup> In England, the first lockdown period was not associated with excess mortality in children.<sup>23</sup>

Multiple factors are likely to have contributed to the observed changes in healthcare utilisation and hospital admissions. These may include changing behaviours of parents and carers, changes in the availability of different routes for healthcare consultation, and changes in disease incidence.<sup>24</sup> At the same time, use of information technology for health expanded greatly: virtual consultations (telemedicine) rose from 15%–20% prior to the pandemic to 50%–60%, calls to the NHS 111 helpline (and the 999 emergency services number) rose by over 143 000 calls during March 2020 (a 12.2% increase on the previous year), and use of the online 111 app averaged over half a million users every day during the same month.<sup>25</sup>

The NPIs put in place to control COVID-19 may have attenuated the normal seasonal increases in transmission of respiratory viral diseases,<sup>26–28</sup> and contributing to lower numbers of admissions for infectious diseases in general.<sup>29</sup> While NPIs reduce the stress on healthcare systems in the short-term, exposure to many common pathogens leads to acquisition immunity, and limited exposure may increase the susceptible population and hence size of future epidemics.<sup>30 31</sup> Yet, the observed impact of NPIs can inform future policy making when considering the use of, sometimes simple to introduce, NPIs to reduce the burden of acute childhood illness, balancing the advantages of doing so against the potential harms and impact on broader child health.

We observed reductions in injury admissions during the first lockdown which returned to seasonal averages when schools partially reopened in June 2020. Other studies suggesting a fivefold rise in the number of domestic accidents<sup>32</sup> and increases in child abuse and neglect leading to large increases in head trauma, and increased calls to child support lines.<sup>33–35</sup>

This study has several limitations inherent from the methodology and nature of the data available. First, our data represent a multicultural, urban population of a major metropolitan city with widely ranging levels of wealth and deprivation, and these might not be reflective of other geographical areas (online supplemental figure 5) for comparative child health profiles for London vs England). A small number of NWL general practices are not part of the WSIC network and hence children registered with these practices would not be part of our database. However; as of June 2019, WSIC collects the data of 365 participating general practices accounting for 95% of the total NWL population.<sup>12</sup> Children who are not registered with any general practice would also not be included. Our approach of analysing ICD-coding groups did not account for more subtle epidemiological changes within these overarching coding groups. For example, studies reported relative unchanged ED attendance rates for urinary tract infections,<sup>3 5</sup> and changes in the number of admissions for relatively infrequent safeguarding related injuries will have gone unnoticed. Likewise, our

study would have benefited from more detailed information on mental health issues to verify the reported rise of mental health issues in primary and secondary care elsewhere.<sup>36 37</sup> We were not able to reliably differentiate between face-to-face and virtual appointments in primary care, nor to assess comorbidities or vaccination status.

In conclusion, mandated lockdowns and NPIs were associated with a reduction in primary and secondary healthcare usage for children in NWL. These decreases were seen directly after these measures were instigated indicating that their rapid deployment reduced the burden on the health system. NPIs against COVID-19 also reduced consultations and admissions for other infections. Using a database compiled of both primary and secondary care data provided a ‘whole system’ view showing that the net effect of the pandemic on acute non-COVID-19 childhood illness and injury in NWL was not the feared increase, but actually a substantial reduction.

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**Ethics approval** The COVID-19 NWL Data Prioritisation Group approved this study (7 August 2020): no reference numbers are given by this committee.

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