HDIG report 3. Why is A&E so busy? Analysis using individual patient data.

Health Data Interpretation Group 29 November 2023
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The Health Data Interpretation Group (HDIG) at the University of East Anglia (UEA) has been commissioned by Norfolk County Council (NCC) to address several questions in 2023. The first question ('question 1a') is: '*What is the impact of COVID-19 on health services activity and health outcomes? Specifically: Why is A&E so busy?*' This question was addressed in two work packages, and this report 2 presents the findings from work package 2:

1) Report 1 (separately available), which consists of a literature review and descriptive analyses using publicly available data, separate report title: 'HDIG report 1. Why is A&E so busy? Analysis using public data' [1]
2) Work package 2 (this report), which consists of statistical analyses using anonymised individual patient record level data, report title: 'HDIG report 2. Why is A&E so busy? Analysis using individual patient data'.

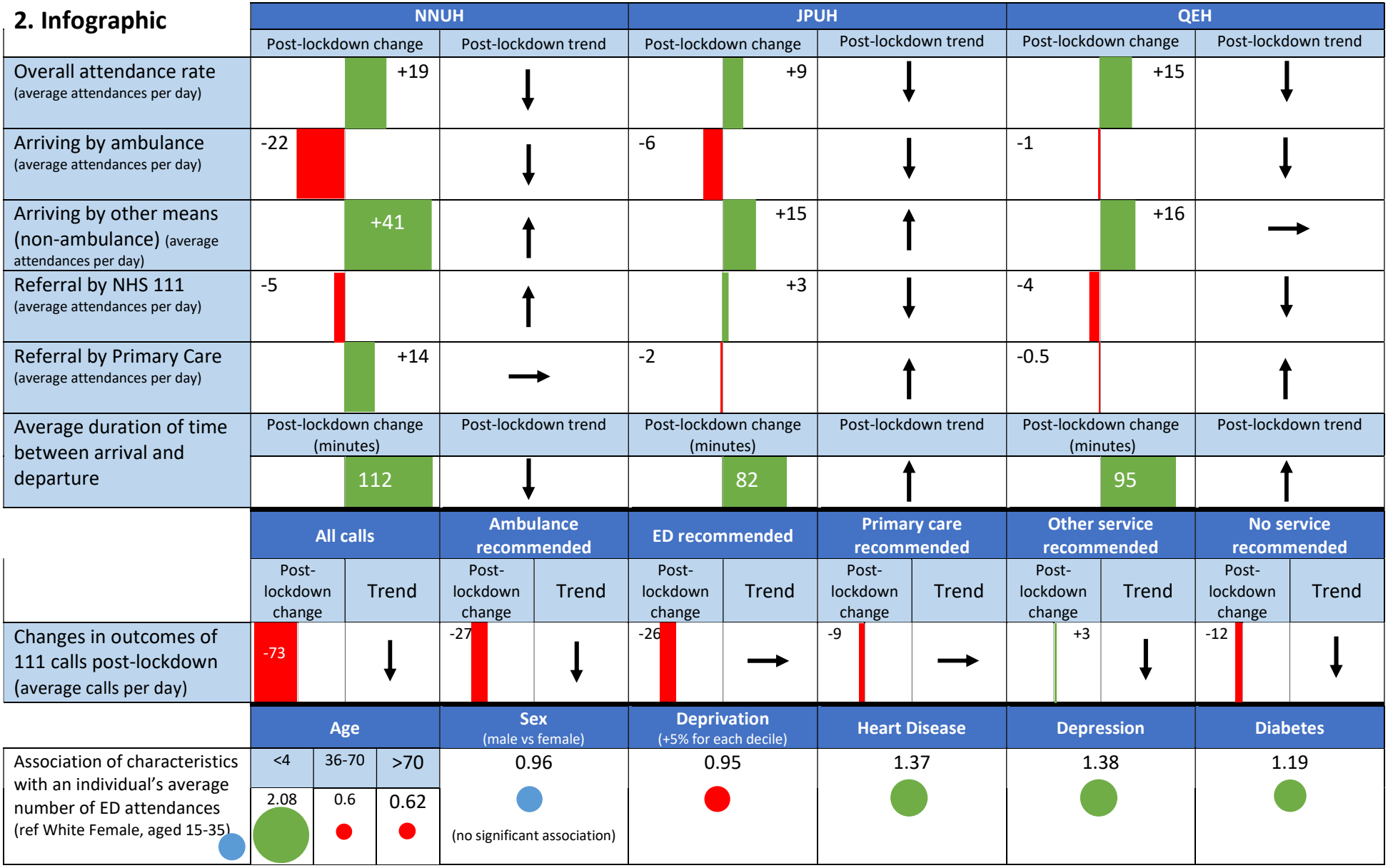
CONTENTS

1. Key findings

We used health care activity data (recorded at the level of discrete events such as each ED visit or ambulance call) to compare urgent and emergency care system activity between 2018 to 2020 and 2021 to 2023. We used an ICB developmental linked patient level dataset to analyse factors associated with ED attendances in 2022 to 2023. This dataset is developmental and the numbers reported in this report should be considered approximate.

- **Daily ED attendances** were higher on average in the post-lockdown period than in the pre-COVID period by 6% (19 more daily attendances) in Norfolk and Norwich University Hospital (NNUH), 5% (9 more daily attendances) in James Paget University Hospital (JPUH) and 10% (15 additional daily attendances) in Queen Elizabeth Hospital (QEH). However, while figures were higher on average for the post-lockdown period, there was a continuing downward trend in attendances post-lockdown in all three hospitals.
- **ED attendances that arrived by ambulance** were lower on average for the post-lockdown period when compared to the pre-COVID period by 17% (22 fewer arrivals per day) in NNUH, 11% (6.4 fewer arrivals per day) in JPUH and 2% (1 fewer arrival per day) in QEH. There was also a continuous decreasing trend post lockdown. **ED attendances that arrived in other ways than by ambulance** were higher in the post-lockdown period; the increase was largest for the NNUH at 22% with continuous increasing trends in NNUH and JPUH.
- The number of referrals to ED by primary care and by NHS 111 over time differed by trust when comparing pre-COVID and post-lockdown, and in post-COVID trends.
- **Time spent in ED departments** was markedly higher on average in the post-lockdown period compared to the pre-COVID period, by 112 minutes in NNUH (up 44%), 82 minutes in JPUH (up 46%) and 95 minutes in QEH (up 47%). These increases cannot be explained solely by higher attendances. In 2022-3, waiting times decreased over time in NNUH but continued to increase in JPUH and QEH.
- **Average waiting times** were greatest for patients who arrived by ambulance: they were on average 255 minutes longer in NNUH post-lockdown compared to pre-COVID (up 77%), 158 minutes longer in JPUH (up 66%) and 210 minutes longer in QEH (up 71%).
- **Ambulance arrivals that ended with delayed handovers of patients** to hospital care were more common post-lockdown. The probability that handover was delayed by more than 60 minutes – which was not often observed in this data before the first lockdown – showed a continuously upward trend post-lockdown of around 20% per year in all of the three trusts.
- **Ambulances callouts** through NHS 111 & 999 calls were 15% fewer in the post-lockdown period compared to the pre-COVID period and show a continuous downward trend post-lockdown.
- **NHS 111 telephone calls** were on average 9% fewer post-lockdown and showed a continuous downward trend post-lockdown.
- **ED attendances during 2022/23** were more likely in people aged under 5 years of age; living in more socioeconomically deprived areas; with a long-term medical condition; with more GP attendances during the same year; or living closer to ED.

2. Infographic



This infographic summarises results from the regression models. Red indicates statistically significant lower values on average in the post-lockdown period (compared to the pre-COVID period), and green higher values. Downward arrows indicate statistically significant continuous downward trends in the post lockdown period, upward arrows indicate upward trends, and horizontal arrows indicate no statistically significant continuous change over time.

3. Introduction

This report from work package 2 follows our report from work package 1 [1], which was an analysis of publicly available data relevant to Urgent and Emergency Care (UEC) in N&W between 2018-20 (pre-COVID) and 2021-23 (post-lockdown). Our first report found substantial increases in ED waiting times (93% increase in those waiting more than 4 hours), comparatively modest increases in attendances (5%), substantial increases in ED staff numbers (41%), and a slight decrease in the availability of care and nursing home beds (2%). Our findings were consistent with those from a National Audit Office (NAO) report on UEC that identified a need to reduce delayed discharge and to scale up intermediate and social care capacity [2].

The aim of work package 2 was to describe, in more detail, changes in the demand for UEC services among the population served by the N&W Integrated Care Board (ICB) from 2018-19 to 2022-23, using individual level data. More detailed methods and results are provided in the technical appendix to this report, which includes full methods and results of all the statistical analyses. The main findings are reported in the body of this report.

4. Definitions

Urgent and Emergency Care covers non-routine health care. Emergency care involves life-threatening illnesses or accidents which require immediate treatment from an accident and emergency department (ED), often via an ambulance service (using 999). Urgent care involves any non-life-threatening illness or injury needing urgent attention which might be dealt with by phone consultation through the NHS 111 Clinical Assessment Service, pharmacy advice, out-of-hours GP appointments, or at a minor injury clinic or walk-in centre [3].

Type 1 emergency departments are medical consultant-led 24-hour services with full resuscitation facilities. Norfolk and Waveney (N&W) has three type 1 departments, at the Norfolk and Norwich University Hospital (NNUH) in Norwich, the James Paget University Hospital (JPUH) in Great Yarmouth, and the Queen Elizabeth Hospital (QEH) in King's Lynn. At the NNUH, type 1 attendances include the Children's Emergency Department and Older People's Emergency Department, but do not include 'Assessment Units'. There are no type 2 (single specialty emergency) services in N&W. Type 3 services provide treatment of minor injuries and illnesses without an appointment. Norfolk and Waveney has two type 3 services, the Norwich Walk-in Centre (Rouen Road) and the Minor Injuries Unit (MIU) in Cromer; during some periods the GP Front Door service has been recorded as a Type 3 department.

In this report "post-lockdown" is used to define the period following the end of the stay-at-home rule of the final (third) lockdown in England, that is, from 30th March 2021 to 31st

March 2023. “Pre-COVID” is used to define the period from the start of the study, 1st April 2018, to the start of the first lockdown on 25th March 2020.

5. Methods

The study covered the N&W ICB area, and the study outcomes were indicators of UEC use. We undertook two main types of analysis. Firstly, we carried out a cross-sectional analysis to identify individual characteristics associated with ED use from April 2022 to March 2023. Secondly, we carried out an interrupted time series analysis describing changes in UEC activity from April 2018 to March 2023.

Data

We used two databases provided by Norfolk and Waveney ICB, the ICB developmental linked patient level dataset 2022-23, and a database of health care activity including hospital trusts, the East of England Ambulance Service and NHS 111.

ICB developmental linked patient level dataset 2022-23

The cross-sectional analysis was carried out with N&W ICB developmental linked patient level dataset 2022-23. This contains data on all individuals who were registered at a GP practice in N&W between 1st April 2022 and 31st March 2023. For the analysis, we only included individuals with a residential address within N&W. Of the 106 GP practices registered in Norfolk and Waveney [4], 91 are included in the patient level dataset 2022-23 (see Appendix A) with 1,043,047 individuals recorded. Using weighted population estimates for 2022-23 for N&W ICB [5], this record covers approximately 90% of the N&W population. The patient level dataset 2022-23 combines data from each individual’s general practice (‘primary care’ data) and from hospital trusts, together with age, sex and ethnicity, as well as indices of multiple deprivation (IMD) [6] decile based on the location of the individual’s residential address. The primary care data included information on long-term medical conditions, and the number of general practice appointments during the year. Hospital data included the number of ED attendances made by the individual during the year. Driving distance from each individual’s area of residence (census lower super output area centroid) to the nearest ED department was calculated.

Healthcare Activity Data

The time series analysis was carried out with health care activity data provided by N&W ICB, who collated data provided by NHS organisations including hospital trusts, the East of England Ambulance Service and NHS 111. The raw data were at the level of individual health service visit, telephone call or ambulance call. We restricted our analyses of these data to individuals whose address was located in N&W or who were registered at a general practice located in N&W, and where activity took place between 1 April 2018 and 31 March 2023. Activity for patients who were neither registered with a GP practice nor had an address located within N&W but who attended hospitals within N&W ‘out of area’ were

excluded. This particularly affects hospitals near county borders, for example QEH, which sees more 'out of area' patients. Similarly, activity at "out of area" hospitals (for example, Peterborough City or West Suffolk Hospital) by patients residing in N&W was excluded.

For the analyses we focused on Type 1 emergency care department data (see 'Definitions' above) for the three major hospitals in Norfolk: NNUH, JPUH and QEH. Type 3 attendances in Norfolk and Waveney are predominantly from the Norwich Walk-in Centre at Rouen Road (excluded from analyses), the Minor Injuries Unit (MIU) in Cromer (included), and GP Front Door attendances (included). This report excludes analysis of attendances to hospital same day emergency care centres, and general practices.

For analysis on 'injury', and 'circulatory problems', we used the categories listed in the Emergency Care Data Set (ECDS) Technical Output Specification which maps SNOMED diagnoses to ICD-10 data [7].

Data from the ICB has also been supplied showing GP Front Door use at the three trusts between 17/12/2019 and 05/09/2023.

Statistical methods

Cross-sectional analyses with the patient level dataset 2022-23

To investigate individual level predictors of the frequency of ED attendances by the residents of Norfolk and Waveney, we statistically analysed the ICB developmental linked patient level dataset 2022-23 using Poisson regression models. The outcome variable was the number of ED attendances made by an individual between 1st April 2022 and 31st March 2023. The covariates in all models included each individual's age, sex, ethnicity, recorded long-term medical conditions and residential IMD decile. We carried out a number of regression models, varying whether we included IMD as a continuous variable (i.e. 1-10), or as a discrete deciles (comparing all other decile to the most deprived), how long-term conditions were coded (either as presence or absence of each condition, or as the number of conditions), and whether we included the individual's number of general practice appointments during the year as a covariate. R statistical software version 4.1.2 (2021-11-01) was used to undertake all data management and statistical analyses.

Time series analyses with Healthcare Activity Data

To describe changes in UEC activity over time we calculated and analysed these variables:

1. **ED attendances**: total number of attendances per day; number of attendances due to injury or circulatory problems, arrival mode, diagnosis (which may differ from the presenting complaint), referral source; time spent in ED; and characteristics of patients. Separate analyses were carried out for each ED department.

2. **NHS 111 calls:** frequency and outcome of 111 calls.

3. **Ambulance calls:** number and type of ambulance calls per day, ambulance response and

handover times. Handover times were analysed separately for each ED department.

Changes over time were analysed using a type of linear regression called interrupted time series regression [8] . The outcomes were the numbers of attendances or calls, or the outcomes of attendances or calls, that occurred each day. The regression analyses included the day of week and month of year as covariates to account for seasonal and weekly variation. We used three models:

Model 1: averages pre-COVID and post-lockdown. We compared the estimated average attendances, 111 calls and waiting times for the pre-COVID period (from 1st April 2018 to 25th March 2020, before the first lockdown) to the post-lockdown period (from 30th March 2021 to 31st March 2023, after the final lockdown). Model 1 included pre-COVID vs post-lockdown as a binary covariate.

Model 2: trends pre-COVID and post-lockdown. We compared trends over time in these measures during pre-COVID and post-lockdown periods. Model 2 included as covariates pre vs post-COVID binary variable, the number of days since 1 April 2018 in the pre-COVID period and days since 30th March 2021 in the post-lockdown period (excluding days from first to third lockdown), and COVID-days interaction.

Model 3: trends pre, during, and post lockdown. We compared trends pre, post and during lockdowns, including changes during each of the three lockdown periods. Model 3 included covariates for whether the time period was pre or post 29th March 2021 (when lockdowns ceased), the number of days since 1 April 2018 (including days from first to third lockdown), COVID-days interaction, and first, second and third lockdown as binary variables.

The following dates were used to identify lockdown periods in Model 3:

- Lockdown 1: 26th March 2020 to 4th July 2020
- Lockdown 2: 5th November 2020 to 2nd December 2020
- Lockdown 3: 6th January 2021 to 29th March 2021

Details of the statistical methods and results are provided in the Technical Appendix B.

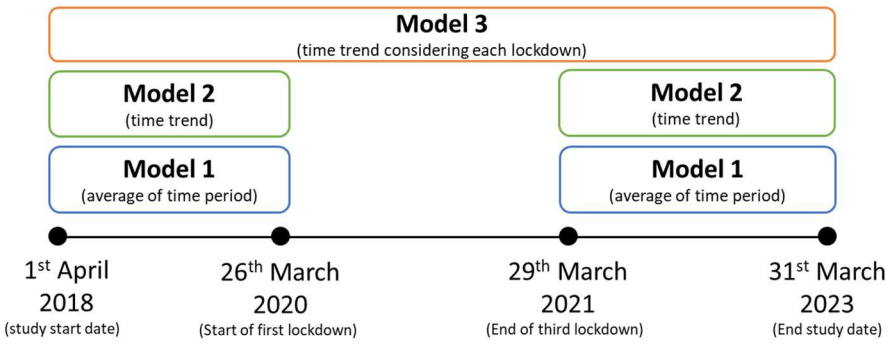


Figure 1: Timeline diagram to explain the three models used: Model 1 - the average pre-COVID and post-lockdown, Model 2 - comparing continuous time trends pre-COVID and post-lockdown, and Model 3, using continuous time trends that considered all three lockdown periods.

6. Results

Full results can be found in the technical report in Appendix B. All changes reported in this section of the main report are statistically significant at the 5% level unless otherwise stated.

Cross-sectional analyses: predictors of ED attendances from 2022 to 2023

1,027,422 individuals (from a total of 1,043,047) had a record of a patient address within N&W and a recorded gender of male or female. 437,858 individuals had no data on long-term conditions and were excluded from analyses which used those variables. 584,522 individuals were excluded from the analysis when both long-term conditions and number of primary care appointments were included in the regression analysis.

Of the 1,027,422 individuals, 84.3% did not attend ED during the year, 11.4% visited ED once, 2.8% visited twice, and 1.5% visited three or more times during the year. In a multivariate analysis of factors predicting ED attendance, the number of attendances in one year was influenced by individuals' age, deprivation, and presence of chronic illness. Figure 2 shows statistically significant results; incident risk ratio (IRR) values over 1 indicate increased likelihood of ED attendance.

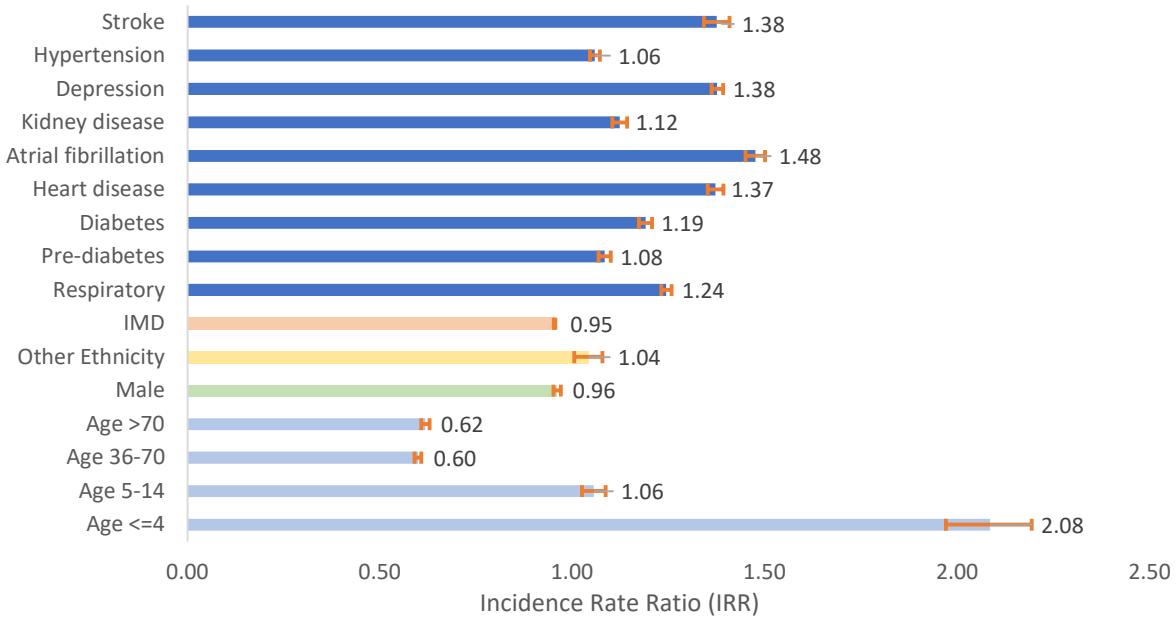


Figure 2: Association of various specific patient characteristics on an individual's number of ED attendances. Reference (comparison) categories for ethnicity, sex and age are White, Female, and age 15-35 years respectively. The IRR for index of multiple deprivation (IMD) is for a one decile difference, with increasing IMD decile representing less deprivation.

The long-term conditions most strongly associated with ED attendances were atrial

fibrillation, heart disease, stroke, and depression (Figure 2). Compared to the reference age group (ages 15-35), those under 5 years were more likely to attend ED and those over 36 were less likely to attend, after controlling for all other variables, including the presence of long-term conditions. Children under five have the highest mean number of visits per individual but were responsible for only 7.3% of all visits because there are relatively few of them compared to the much bigger numbers of adults (Table 1).

Table 1: ED attendance by age group April 2022 to March 2023

Age band	Number of individuals in dataset	Number of ED visits	% of Total visits	Mean number of visits per individual
Less than 5	37,987	17,400	7.3	0.46
5-14	98,072	24,403	10.3	0.25
15-35	214,489	54,377	22.9	0.25
36-70	429,852	79,892	33.6	0.19
Over 70	247,022	61,447	25.9	0.25
Total	1,027,422	237,519	100.0	0.23

Average numbers of ED attendances increased steadily with deprivation, with individuals in the least deprived decile (IMD10) 39% less likely to attend ED than individuals in the most deprived decile (IMD 1) (Figure 3). More ED attendances were also associated with the number of long-term medical conditions recorded by the GP, and with more GP attendances during the same year. There were fewer ED attendances with increasing distance from area of residence to nearest ED department.

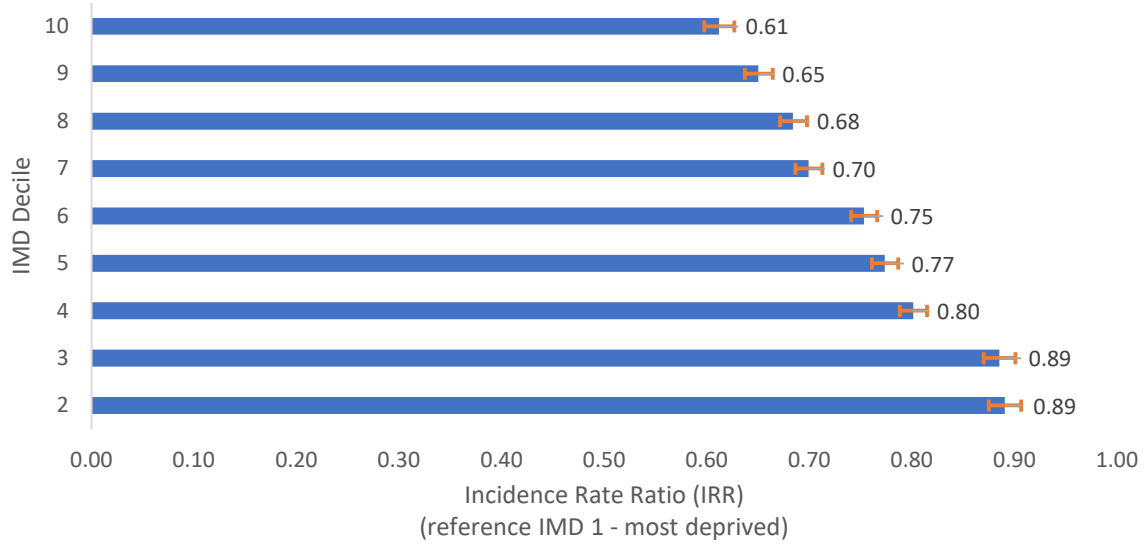


Figure 3: Association between index of multiple deprivation and rate of ED attendances, when controlling for age, sex, ethnicity, and distance in km to the nearest hospital and squared distance.

Time series analyses: comparing pre-COVID with post-lockdown

Interpreting results from model 1 and model 2

In this section we present results from models 1 and model 2 (see methods section above for a fuller explanation). Results from model 1 are the differences in average attendances from pre-COVID to post-lockdown. Results from model 2 are the continuous trends over time during pre-COVID and post-lockdown respectively. This is illustrated in Figure 4 which is for attendances at NNUH. The average number of ED attendances at NNUH per day increased in N&W between the pre-COVID and post-lockdown period (the vertical difference between the horizontal blue lines in Figure 4)[1]. Daily attendances were increasing over time pre-COVID, then decreasing gradually over time post COVID (the sloping red lines in Figure 4).

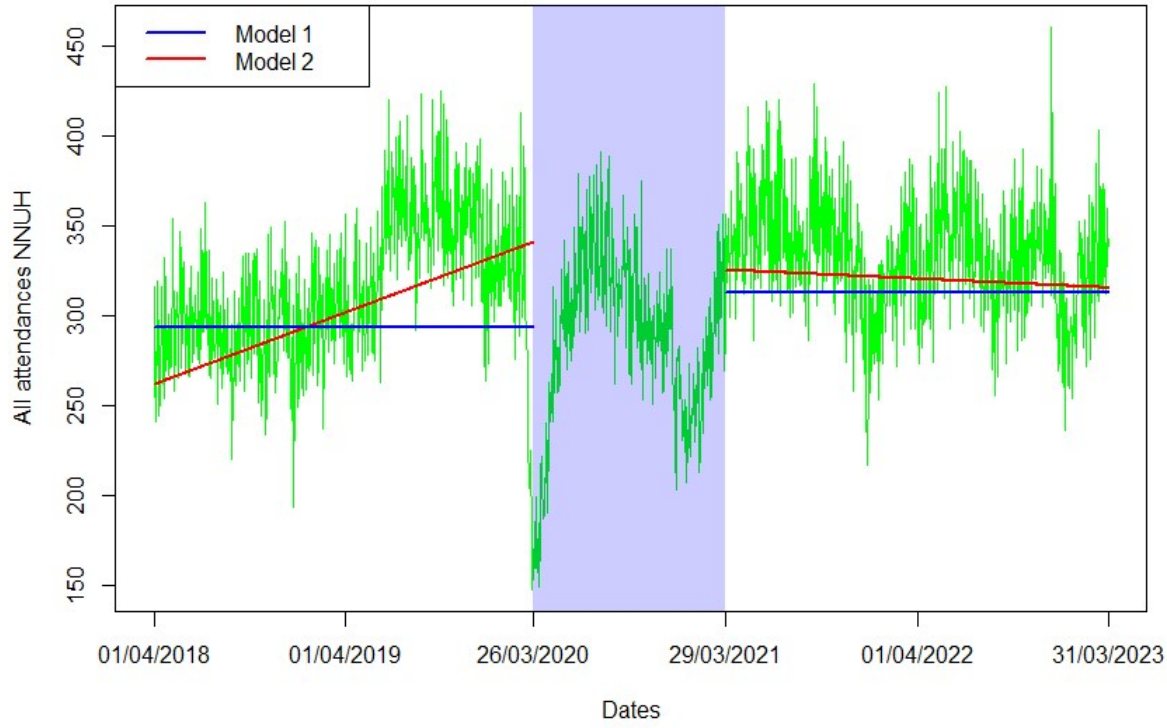


Figure 4: ED daily attendances in NNUH fitted to data with Model 1 (comparing averages between periods), and Model 2 (considering the changes within each period).

Emergency department attendances

Background

Between 1st April 2018 and 31st March 2023 there were 519,152 individuals in the data selected for analysis, who made 1,193,359 total ED attendances. Of these attendances, 48.4% were to NNUH, 29.2% to JPUH and 22.3% to QEH. 48.1% were male and 51.9% were

[1] Note that the blue line for 'pre-Covid' is 'adjusted' in the chart to reflect the regression model, it may be slightly different from pre-Covid means reported in the data.

female (54 attendances had unspecified gender). 83.6% were White British ethnicity (collected by clerical staff using ethnicity categories from the 2001 census).

During this period, 98.5% of all ED attendances were for the first time and the remainder were for planned or unplanned subsequent attendances at the same department for the same incident as the first attendance. The most common reasons for ED attendance were injury (29.5%), respiratory disease (8.6%), circulatory problems (8.1%) and digestive system problems (6.6%). 34.1% of ED attendances arrived by ambulance (including helicopter/air ambulance.

Changes in frequency of ED attendances

Average ED attendances per day were higher in the post-lockdown period for all three hospitals, by 6.1% (19.1 attendances) per day at NNUH, 4.7% (9.0 attendances) at JPUH, and 10.4% (14.9 attendances) at QEH compared to the pre-COVID period (Figure 5a).

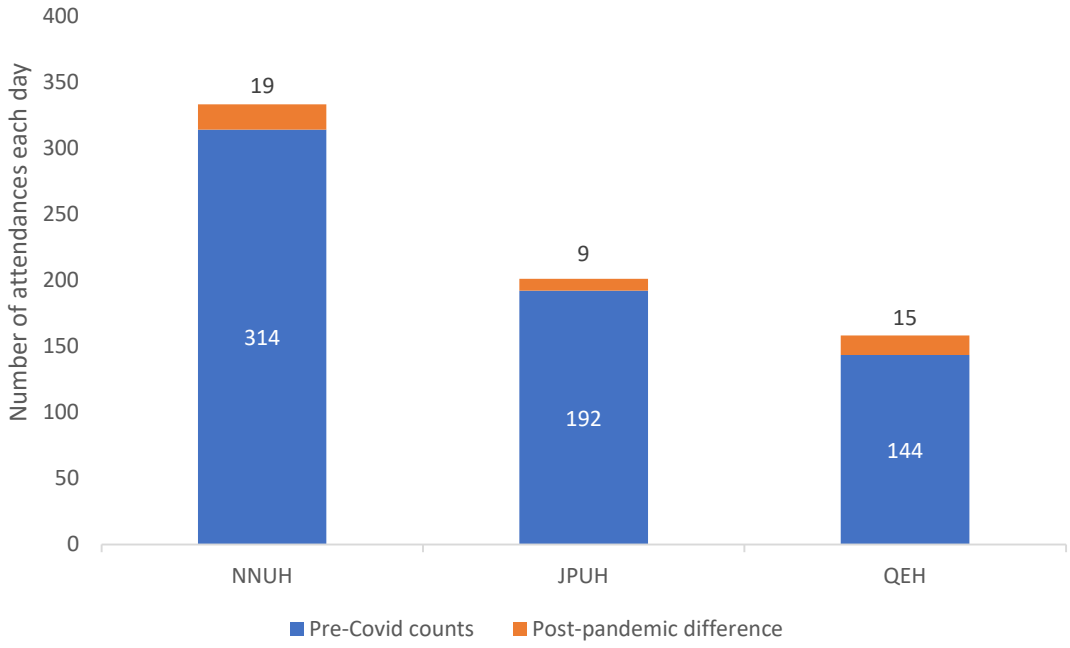


Figure 5a: Average number of attendances per day pre-COVID and post lockdown (Model 1) in ED

Though average daily attendances were higher in the post-lockdown, there was a continuous decreasing trend in all three hospitals of approximately 5 fewer daily attendances per year (NNUH: -4.9, JPUH: -5.3, QEH: -4.5) compared to pre-COVID.

Figure 5b shows that changes in numbers of monthly ED visits were similar in different age groups.

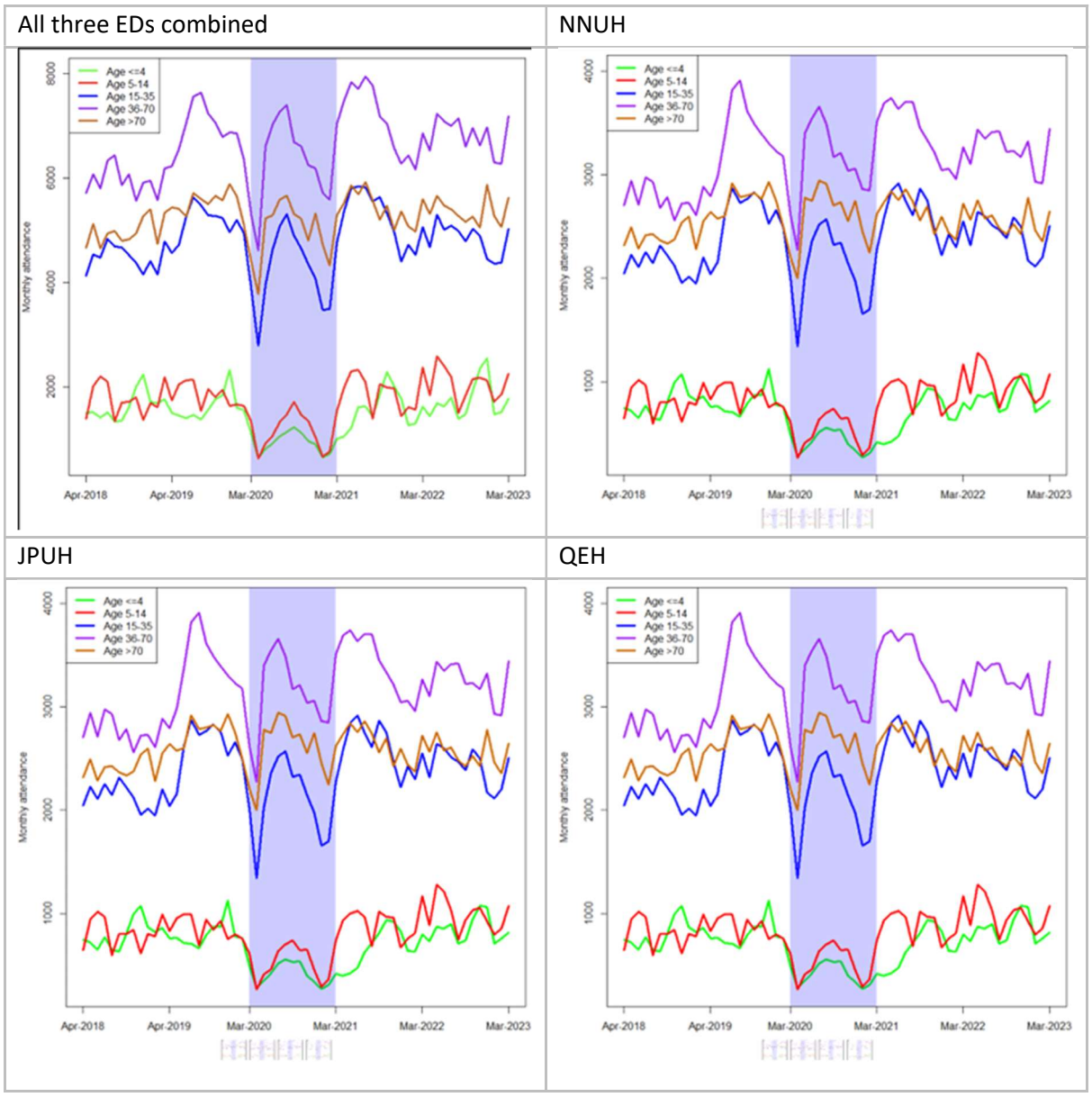


Figure 5b. Total monthly visits to each ED, and to all three EDs combined, for different age groups.

Arrival mode

Arrivals by ambulance at the NNUH, JPUH and QEH were 244,359, 117,542 and 88,812 respectively during the period 2018-19 to 2022-23 and consisted of 34.1% of all attendees overall at all three trusts. The average number of daily ED arrivals by ambulance decreased post-COVID compared to pre-COVID by 17.3% (22 fewer arrivals per day on average) in NNUH, 10.5% (6.4 fewer arrivals) in JPUH and 2.4% (1 fewer arrival) in QEH, with an increase in arrivals not by ambulance (that is, arrivals by any other method excluding ambulance, for example by foot) estimated using Model 1 (Figure 6).

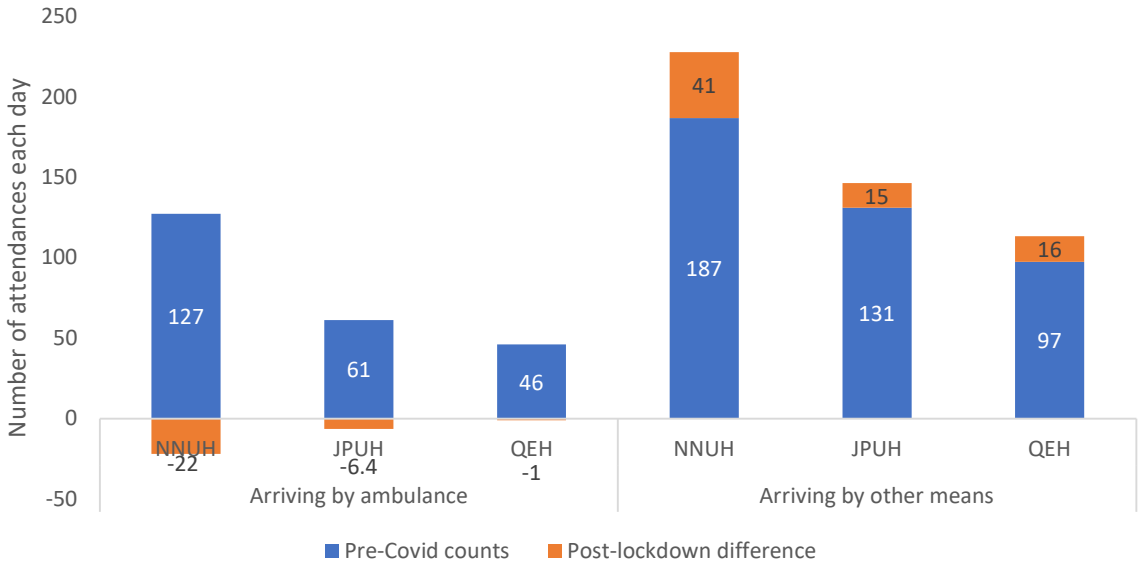


Figure 6: The difference in average daily ED attendances arriving my ambulance and arriving not by ambulance pre-COVID and post lockdown (Model 1)

Time trends from model 2 show a continuous decreasing trend post-lockdown in the number of ambulance arrivals in all three EDs, with average daily attendances decreasing by 22.7 per year at NNUH, 9.5 per year at JPUH and 6.4 per year at QEH. In contrast, there was a continuous increasing trend post-lockdown in daily attendances arriving by other means in NNUH and JPUH, with average daily attendances increasing by 17.8 per year at NNUH and 4.2 per year JPUH, and no statistically significant change at QEH.

Diagnosis

The commonest ED discharge diagnosis category was injury. The average daily number of patients with an injury increased in the post-lockdown period compared to pre-COVID in all hospitals: by 5.4 attendances at NNUH, 1.2 at JPUH 1.2 and 3.1 at QEH (Figure 7). Post-lockdown trends show a significant increase in injury-related attendances at NNUH (up 12 per year), a significant decrease in JPUH (down 6) and no significant change at QEH.

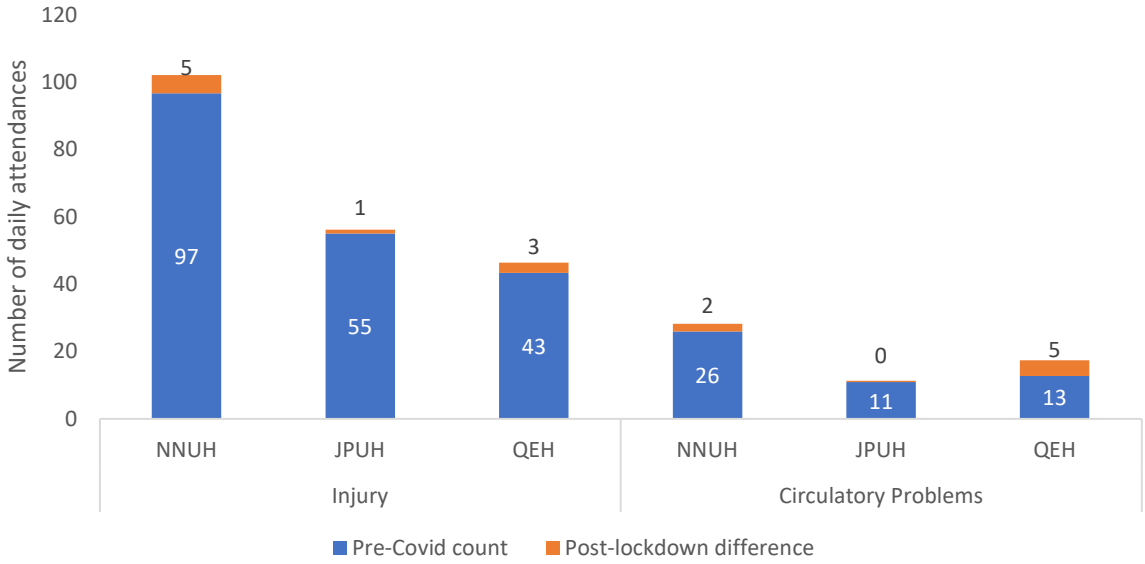


Figure 7: The difference in average daily ED attendances for injury and circulatory problems pre-COVID and post lockdown (Model 1)

As reported above, in the cross-sectional analysis using the patient level dataset 2022-23, the long-term conditions most strongly associated with ED attendances included atrial fibrillation, heart disease, and stroke (Figure 2). The average number of people presenting to ED with circulatory problems was higher post-lockdown than pre-COVID in all three hospitals (model 1), with a continuous decreasing trend post-lockdown at the NNUH (2.3 fewer daily attendances per year) and an increasing trend at QEH (0.9 more attendances per year) while JPUH remained level.

Referral source

Referral source includes both formal routes of referral, for example by a GP, as well as self-reported referral routes recorded by clerical staff on arrival to ED. The average number of ED attendances per day for patients referred by the primary health care team (PHCT) post-lockdown increased at NNUH by 14 attendances per day but decreased in JPUH by 1.7 (Figure 8). The continuous time trends show that numbers of ED patients referred by PHCT increased on average by 2.5 and 2.6 daily attendances per year during the post-lockdown period in JPUH and QEH, with no significant change observed in NNUH.

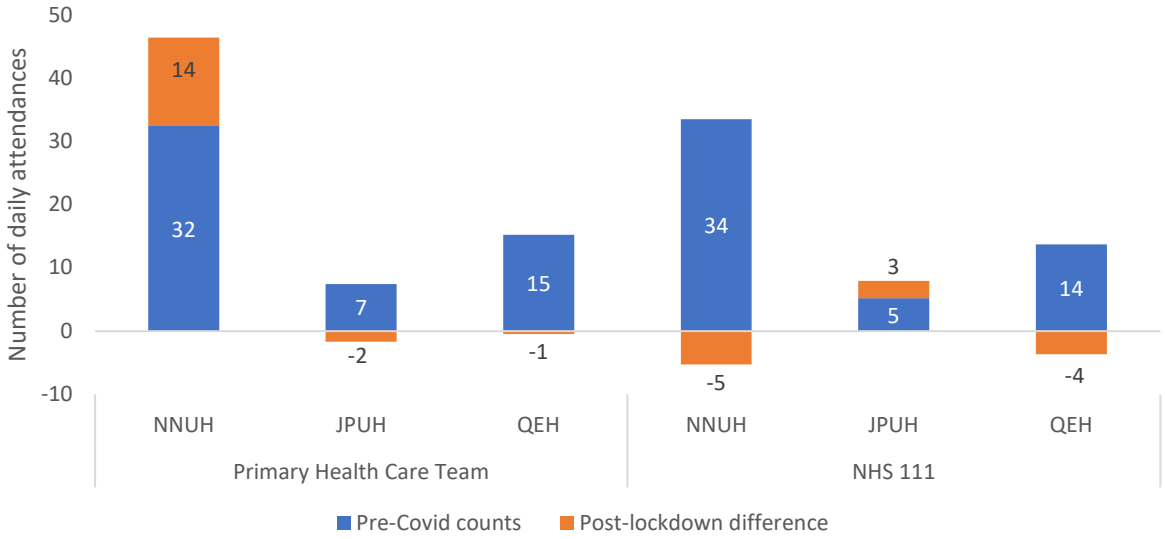


Figure 8: The difference in average daily ED attendances for patients referred by the PHCT and NHS 111 calls between pre-COVID and post lockdown (Model 1)

The average daily number of ED patients referred by NHS 111 during the post-lockdown period decreased in NNUH by 5.3 and QEH by 3.7 and increased in JPUH by 2.7. Post-lockdown continuous trends showed this was increasing at the NNUH with an extra 2.2 patients referred by NHS111 per day each year and decreasing at QEH by 2.1 patients.

Changes in duration of time spent in ED

The average time between arrival at and discharge from ED departments increased at all hospitals post-lockdown, by 112 minutes in NNUH (up 44.3%), 82 minutes in JPUH (up 45.9%) and 95 minutes in QEH (up 46.6%).

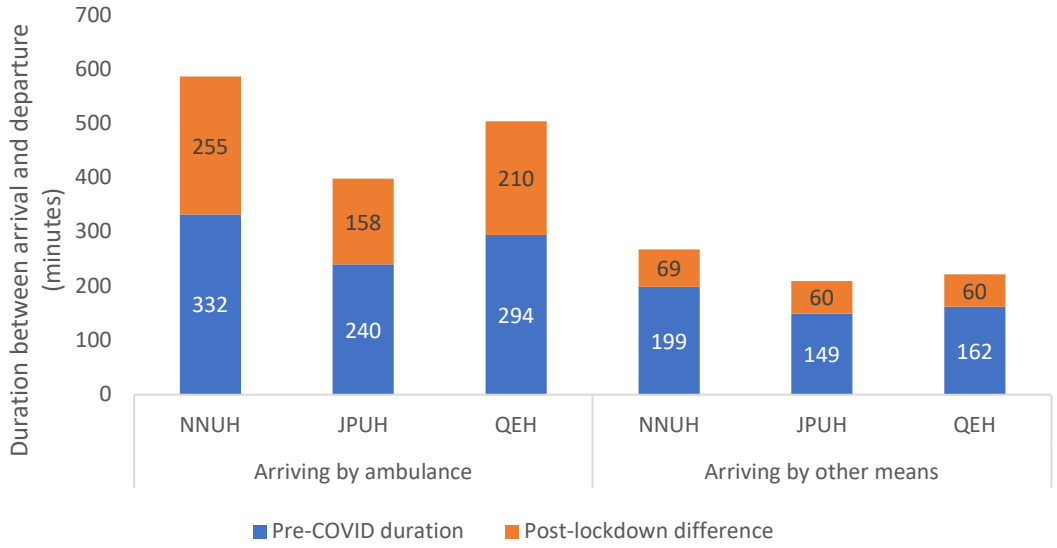


Figure 10: The difference in average time duration between ED arrival and discharge pre-COVID and post lockdown (Model 1)

These increases in time spent at ED were greatest for patients who arrived by ambulance. Average times spend at ED were 255 minutes longer in NNUH post-lockdown (up 76.7%), 158 minutes longer in JPUH (up 66.1%) and 210 minutes longer in QEH (up 71.3%) (Figure 10. This may be because those who arrive by ambulance are more likely to require admission and wait for a bed than those who walk in.

Figure 9 displays the average time between arrival and discharge at the three hospitals, including average waiting time in ED in blue lines, and trends in waiting times in red lines as follows:

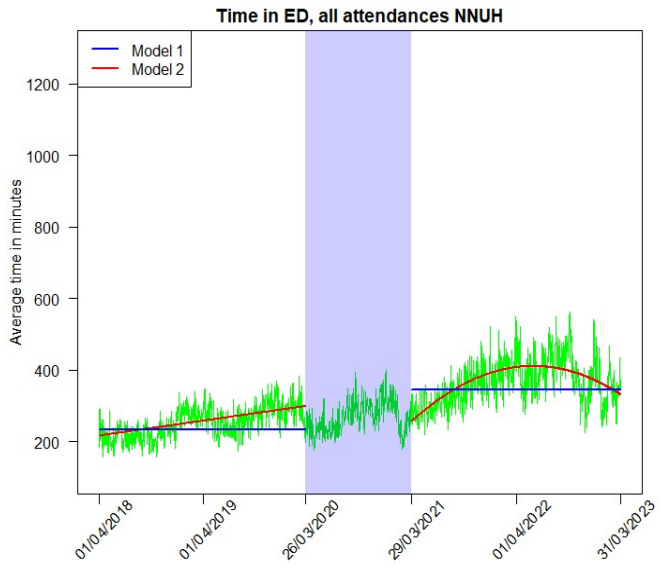
- All ED attendances in NNUH (a), JPUH (b), QEH (c)
- Ambulance arrivals in NNUH (d), JPUH (e), QEH (f)
- Arrival by other means in NNUH (g), JPUH (h), QEH (i)

Discharge from ED may be through the patient being discharged to place of residence, self-discharge, or admission to hospital.

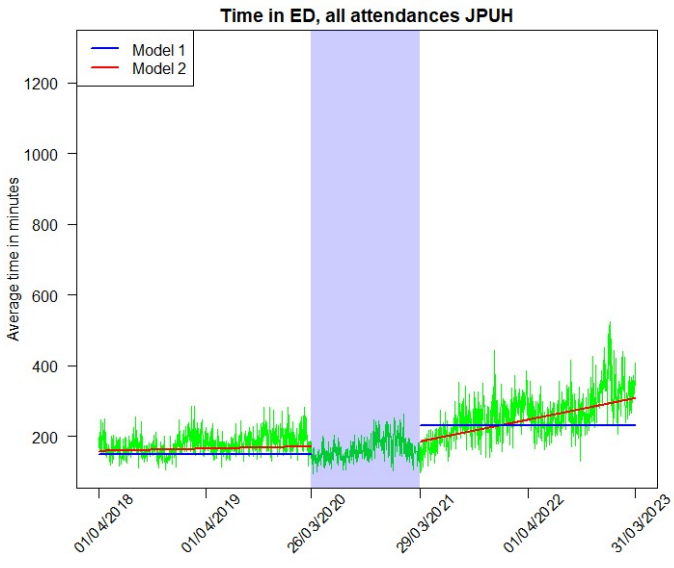
Continuous time trends post lockdown show that, for those arriving by ambulance, at NNUH the mean time spent at ED first increased and then decreased (Figure 9d). At JPUH, the average time at ED increased by 139 minutes per year (Figure 9e), and it almost doubled at QEH (increased by 236 minutes per year) (Figure 9f).

For those arriving by other means (not by ambulance) at NNUH, average time at ED also first increased and then decreased post-lockdown (Figure 9g). There was an increasing trend in average waiting time during the post-lockdown period in JPUH (increasing by 42.4 minutes per year (Figure 9h)) and QEH (increasing by 65.5 minutes per year (Figure 9i)).

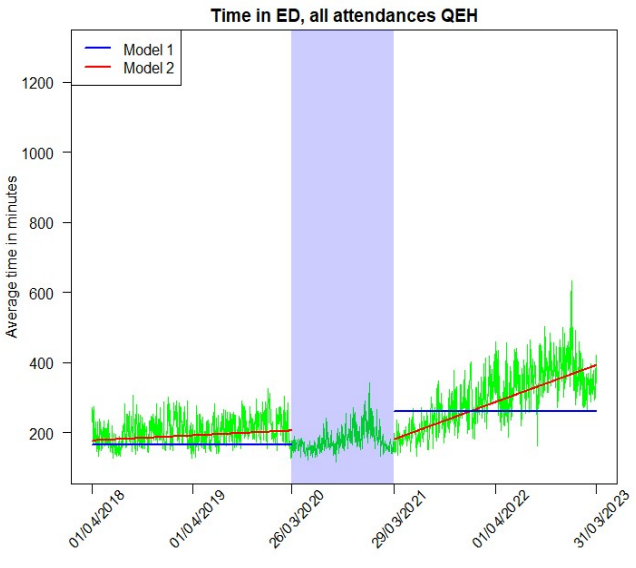
a)


Time in ED, all attendances NNUH
Model 1
Model 2
Average time in minutes
1200
1000
800
600
400
200
01/04/2018
01/04/2019
26/03/2020
29/03/2021
01/04/2022
31/03/2023

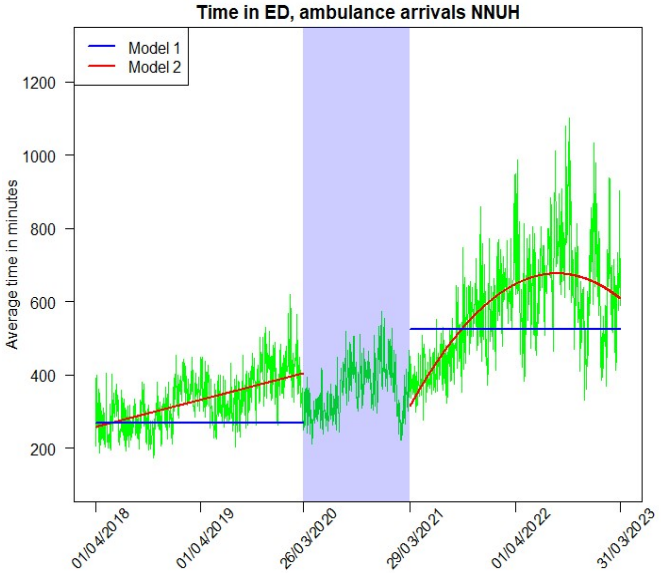
b)


Time in ED, all attendances JPUH
Model 1
Model 2
Average time in minutes
1200
1000
800
600
400
200
01/04/2018
01/04/2019
26/03/2020
29/03/2021
01/04/2022
31/03/2023

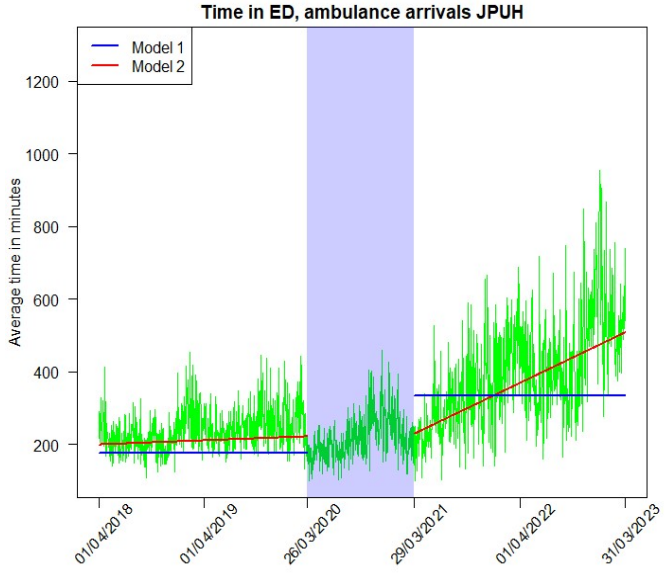
c)


Time in ED, all attendances QEH
Model 1
Model 2
Average time in minutes
1200
1000
800
600
400
200
01/04/2018
01/04/2019
26/03/2020
29/03/2021
01/04/2022
31/03/2023

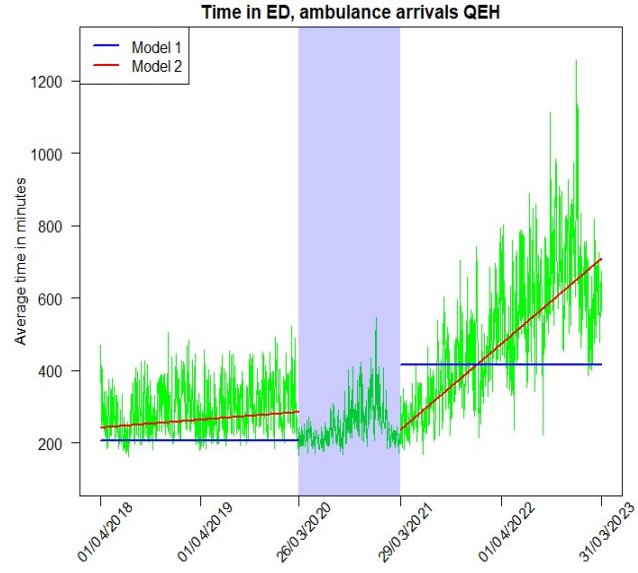
d)


Time in ED, ambulance arrivals NNUH
Model 1
Model 2
Average time in minutes
1200
1000
800
600
400
200
01/04/2018
01/04/2019
26/03/2020
29/03/2021
01/04/2022
31/03/2023

e)


Time in ED, ambulance arrivals JPUH
Model 1
Model 2
Average time in minutes
1200
1000
800
600
400
200
01/04/2018
01/04/2019
26/03/2020
29/03/2021
01/04/2022
31/03/2023

f)


Time in ED, ambulance arrivals QEH
Model 1
Model 2
Average time in minutes
1200
1000
800
600
400
200
01/04/2018
01/04/2019
26/03/2020
29/03/2021
01/04/2022
31/03/2023

g) *h)* *i)*

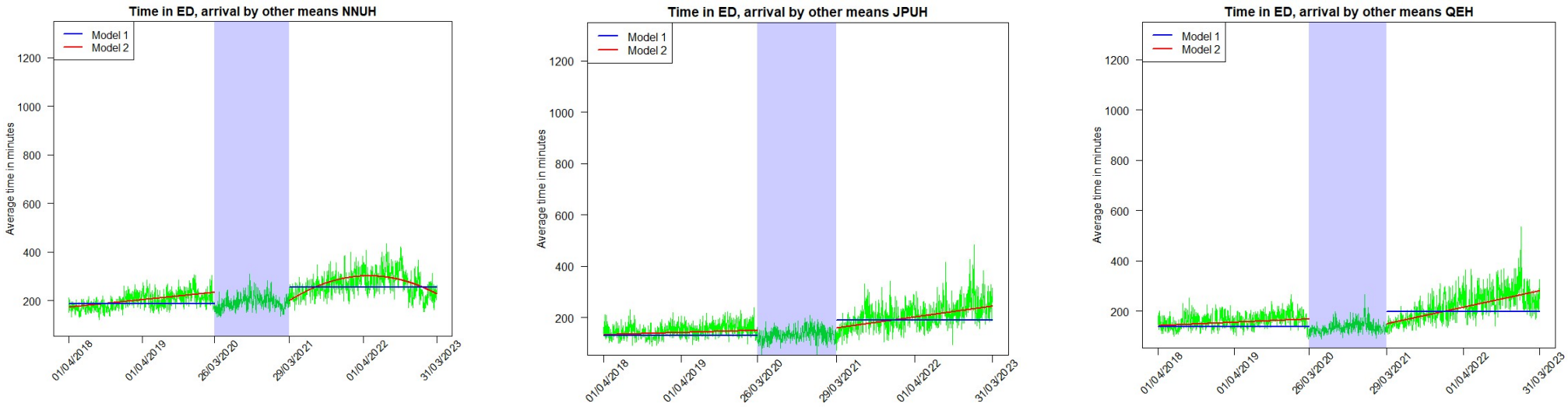


Figure 9: Time patients spent at ED from arrival to discharge or hospital admission: (a) All ED attendances in NNUH, (b) All ED attendances in JPUH, (c) All ED attendances in QEH, (d) Ambulance arrival in NNUH, (e) Ambulance arrival in JPUH, (f) Ambulance arrival in QEH, *(g) Arrival by other means in NNUH, (h) Arrival by other means in JPUH, (i) Arrival by other means in QEH, showing average duration to discharge with applied Models 1 (blue) and 2 (red).*

NHS 111 Telephone Calls

Changes in frequency of NHS 111 telephone calls

There were 1,461,880 NHS 111 calls during the period 2018-19 to 2022-23. Of these calls, 56.0% (n=818,520) were from females, 43.7% (n=639,427) were from males and the remaining 3933 calls did not specify their gender. Daily rates of NHS 111 calls in Norfolk and Waveney were 10.2% lower post-lockdown compared to pre-COVID and continued to decrease steadily.

Changes in outcomes of 111 calls

Pre-COVID, more than half of the patients (53%) were recommended by NHS 111 to attend primary and community care service (PCCS), followed in frequency by a recommendation to call an ambulance (15.4%). Post-lockdown, recommendations for an ambulance were 20.9% lower on average compared to pre-COVID, recommendations for ED attendance were 33.7% lower, and recommendations to attend primary and community care (more than half of all calls) were 2% lower (Figure 11). Post-lockdown, 6% of average daily calls to NHS 111 were recommended to go to ED, compared with almost 9% in the pre-COVID period. Recommendations to PCCS and recommendations to attend ED remained stable post-lockdown, and all other recommendation types showed a downward trend.

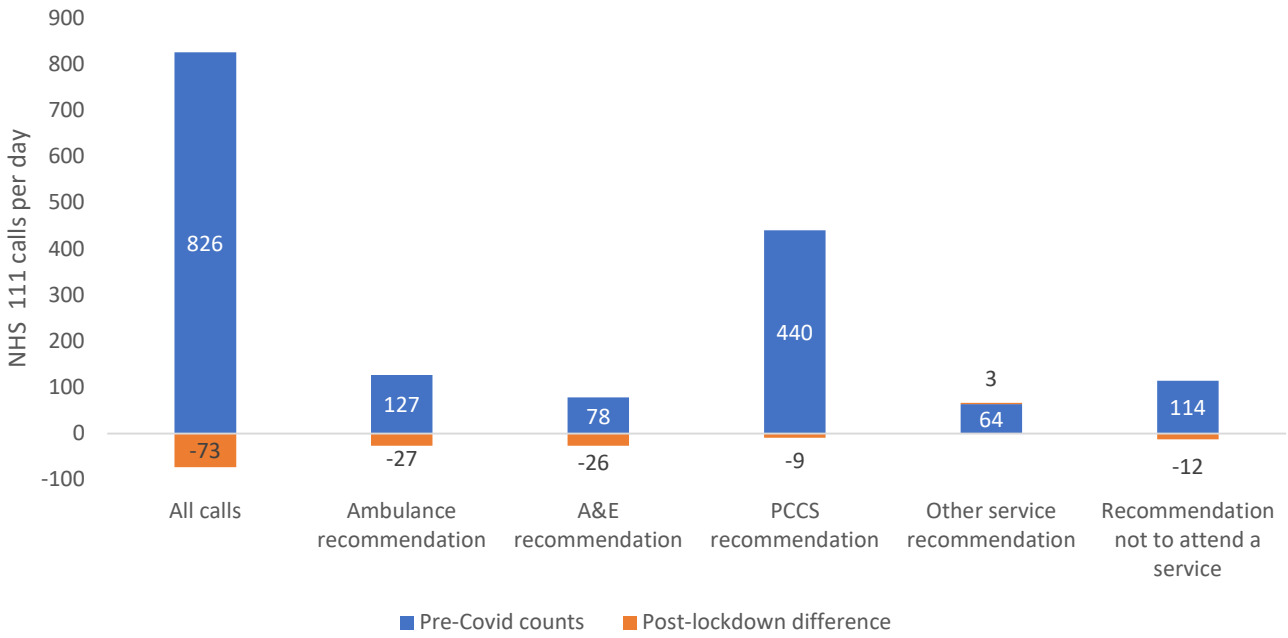


Figure 11: The difference in average number of NHS 111 calls per day and their outcomes pre-COVID and post lockdown (Model 1)

Changes to NHS 111 online services

Data for NHS 111 online services (accessed digitally as an alternative to the phone service) are not available within the ICB dataset, and therefore cannot be analysed in the same way. For context, publicly available data recorded from January 2021 shows increases in the use of the online service in N&W between 2021/22 (n= 118,220) and 2022/23 (n= 135,716) by 15% [9]. Increases in the use of digital access to NHS 111 may be associated with decreases in phone calls.

Ambulance Calls and Handovers

Changes in frequency of ambulance calls and duration of handovers

78.9% of ambulance calls were received through 999, and 21.1% through 111. On average, there were 14.7% fewer daily ambulance calls during the post-lockdown period (for calls made through either NHS111 or 999) when compared to pre-COVID (Figure 12).

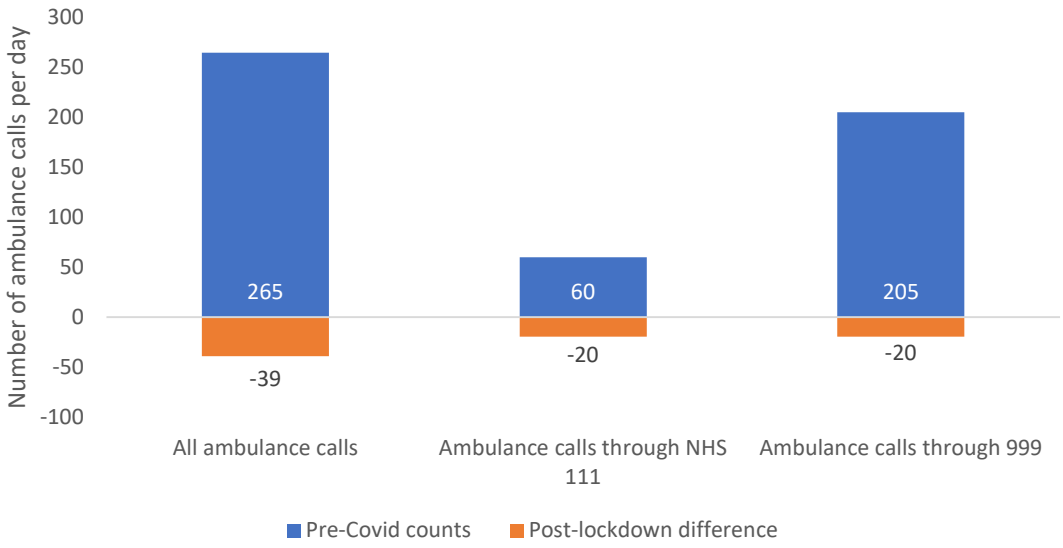


Figure 12: The difference in average number of ambulances calls per day through NHS111 and 999 pre-COVID and post lockdown (Model 1)

During the post-COVID period, trends show that average daily ambulance callouts were decreasing by 45 calls every year for calls made either through NHS111 or 999. Average daily callouts through NHS 111 were decreasing by 10.4 and through 999 by 34.6 calls every year.

Ambulance handover refers to the process of moving a patient from an ambulance to ED upon arrival at a hospital. The average percentage of ambulance arrivals with handover duration of both more than 30 minutes and more than 60 minutes increased in all three hospitals during post-lockdown compared to pre-COVID (Figure 13).

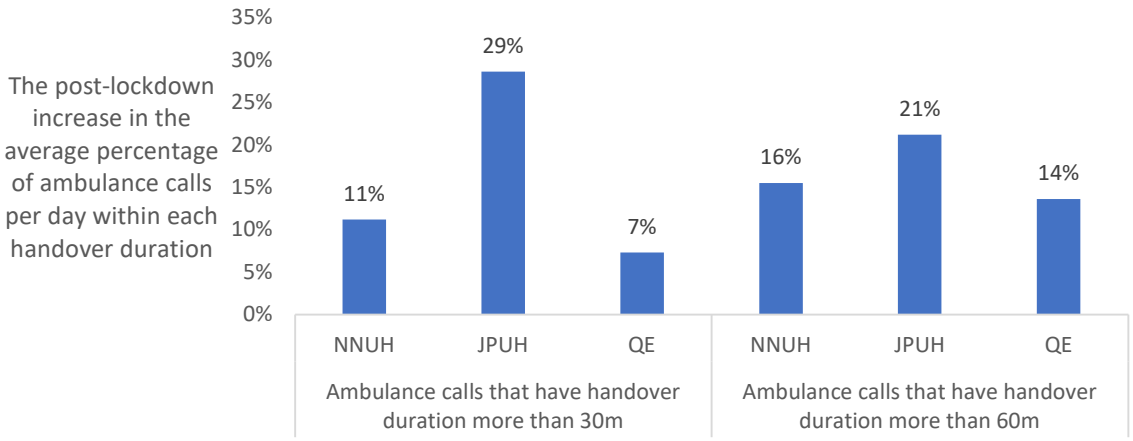


Figure 13: (30 minutes or 60 minutes) compared to pre-COVID percentages.

Trends in all three hospitals were for the percentage of ambulance arrivals with handover duration longer than 30 minutes and 60 minutes to increase by around 20% per year post-lockdown.

Type 3 Attendances

Type 3 attendances (including the Cromer Minor Injury Unit, and some GP Front Door activity at the JPUH and NNUH) decreased by 44 attendances a day post-lockdown compared to pre-COVID, when there had been an average of 89 attendances per day. Post-lockdown the trend was level. However, interpreting Type 3 data is challenging as some GP Front door activity was counted as Type 3 at JPUH and NNUH.

GP Front Door services

All three hospitals have a GP Front Door service which sees patients deemed suitable on arrival at ED. They ran for different time periods, and the NNUH service started as a feasibility study [10] on a limited number of weekdays depending on staff availability.
Data from the ICB has also been supplied to us showing the trend in GP Front Door use over time, showing increasing use at all three hospitals. Furthermore, screening criteria differ across the sites which will affect attendances [11]. Numbers of attendances at the services are relatively small compared to attendances at the main ED and charts indicate an increasing trend over time (Figure 14). We did not carry out statistical analyses of these data because there were very few pre-COVID data.

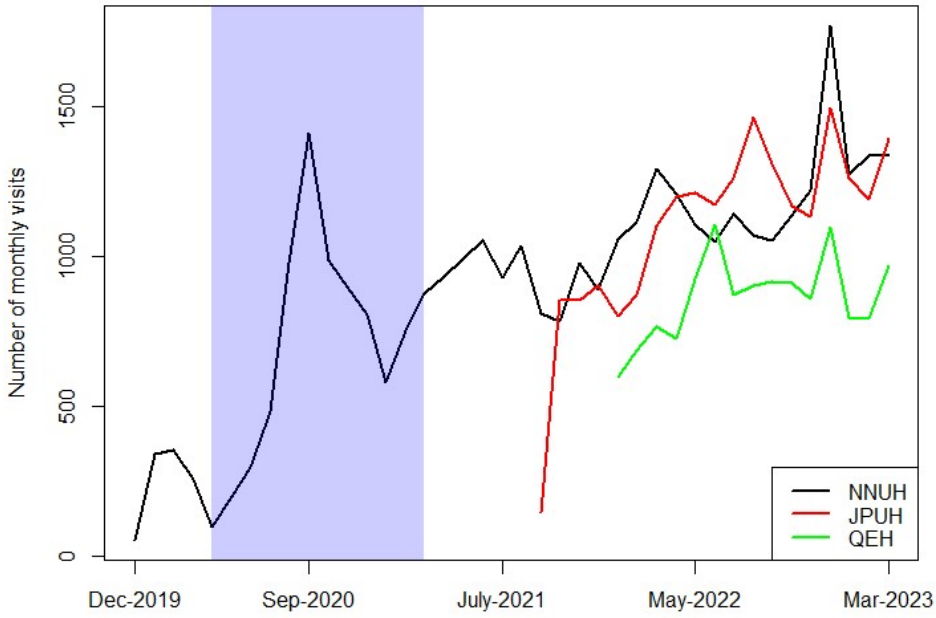


Figure 14: Attendances to GP Front Door services at NNUH, JPUH, and QEH between December 2019 and March 2023, Source: N&W ICB

7. Conclusion

Summary of main results

In the post-lockdown period compared to the pre-COVID period, average daily visits to each ED increased by between 6.1% and 10.4%. These increases were due to patients who did not arrive by ambulance. There was a small increase in ED attendances by patients referred by GPs. NHS 111 calls decreased, including those that recommended patients attend ED. In contrast to the slight increase in ED attendance, waiting times at ED increased substantially, and continued to increase steadily (except in NNUH where they decreased during the most recent 2022-23 year). The biggest and most rapid changes were the decreased rates of patients taken to ED by ambulance. Patients were also increasingly likely to have delayed handovers from ambulance to hospital care. Since the third lockdown the probability that handover was delayed by more than 60 minutes – which was much less often observed in the data before the first lockdown - increased steadily by 20% per year at NNUH, by 22% per year at JPUH and by 19% at QEH. Similarly, the probability that handover was delayed by more than 30 minutes increased steadily by 20% per year at NNUH, by 27% per year at JPUH and by 19% at QEH.

Comparison with report from Work Package 1

This report from work package 2 is consistent with the findings from publicly available data presented in our report from Work Package 1, that ED attendances have increased slightly, and waiting times have increased substantially [1]. It seems implausible that slight increases in

ED attendances are solely responsible for the increasingly long waits at ED, decreasing ambulance callouts, and increasing ambulance handover delays observed over the past two years.

This report from work package 2 adds the important information that, although overall ED attendances have increased, attendances by ambulance and attendances recommended by NHS 111 both decreased. Ambulance handovers are increasingly delayed, suggesting this may contribute to decreases in ED visits arriving by ambulance, and to increased arrival by other means. It is possible that long waits for handover resulted ambulances being held up, leading to long waits for ambulances in the community, with people therefore more likely to make their own way to ED.

The report also shows that ED attendances were most likely in those aged under 5 years of age, followed by those aged 15-35, and were least likely for those aged 36-70. ED attendances were more likely among Norfolk and Waveney residents with long-term medical conditions and those living in more deprived areas.

Strengths and limitations

A strength of this study is the size of the patient level dataset 2022-23 and hospital activity datasets that were used for the analyses. This report is the first external use of the ICB developmental linked patient level dataset 2022-23, which has great potential for improving patient care in the ICB. However, the dataset is still developmental and incomplete, and the numbers reported in this report should be considered approximate.

A limitation is that due to differences in data recording, results are not entirely comparable over the years, and it has been difficult to interpret patterns of use between Type 1 (hospital ED) and Type 3 (walk-in centres, minor injuries units, GP Front Door services) attendances.

Data for attendance has only been collected by those with an address or registered general practice located in N&W, therefore excluding attendances from residents out of area. This has particularly affected Queen Elizabeth Hospital in Kings Lynn which lies on the border of West Norfolk, South Lincolnshire and East Cambridgeshire, serving a large proportion of out of area patients.

Implications

It appears that ED is managing a critical bottleneck in the urgent and emergency care system, where patients cannot be efficiently assessed, treated, and admitted or discharged to release capacity to attend to other waiting patients. This results in ambulances being unable to hand over patients and attend to other calls which explains the decreasing rates of ambulance callouts; this has been a national problem since Covid-19 [12 13]. There have also been anecdotal increases in difficulties requesting ambulances from primary care, including longer delays compared to ambulances routed outside of primary care and policy

introduced in 2019 requiring GPs to provide a score for the level of emergency [14 15].

It has been claimed that the main reason that ED departments are unable to promptly treat, discharge or admit patients is the lack of available hospital beds [2 16]. Analysis of patient care within ED departments and hospitals was however beyond the scope of this study.

The findings of this report support the conclusions from report 1, that potential solutions for A&E are likely to involve the broader health and social care system (including mental health services, intermediate care services, and social care) in the short and long-term, rather than solely investing in ED capacity. Increasing health or social care bed availability to improve discharge from hospital could be addressed within the Norfolk and Waveney Integrated Care System Joint Forward Plan (2023-2028) [17], under 'Ambition 5: Transforming Care in Later Life' or 'Ambition 6: Improving Urgent and Emergency Care'. These conclusions fit with the recommendations made pre-pandemic by the Boston Consulting Group when they worked with the Norfolk and Waveney System and identified mismatches in demand and capacity that could not be overcome by a single provider but only by the entire health and care system working collectively and integrating further. Similar recommendations were in the in the NHS Delivery plan for recovering urgent and emergency care services [16].

Acknowledgement

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2019 [Available from: https://www.pulsetoday.co.uk/news/urgent-care/gps-requesting-ambulance-will-have-to-provide-a-score-for-level-of-emergency/. accessed 8th September 2023]
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9. Appendices

Appendix A) patient level dataset 2022-23:

This database includes linked data for 91 of 106 general practices in N&W listed below:

Acle Medical Partnership	Manor Farm Medical Centre
Aldborough Surgery	Market Surgery
Alexandra & Crestview Surgeries	Mattishall Surgery
Andaman Surgery	Mundesley Medical Centre
Bacon Road Medical Centre	Nelson Medical Centre
Beaches Medical Centre	Norwich Practices Health Centre
Beccles Medical Centre	Oak Street Medical Pract.
Beechcroft and Old Palace	Old Catton Medical Practice
Birchwood Medical Practice	Old Mill and Millgates Medical Practice
Boughton Surgery	Orchard Surgery
Bridge Road Surgery	Paston Surgery
Bridge Street Surgery	Plowright Medical Centre
Brundall Medical Partnership	Prospect Medical Practice
Bungay Medical Centre	Reepham & Aylsham Medical Practice
Burnham Surgery	Rosedale Surgery
Castle Partnership	Roundwell Medical Centre
Coastal Villages Practice	School Lane Pms Practice
Coltishall Medical Practice	School Lane Surgery
Cromer Group Practice	Sheringham Medical Practice
Cutlers Hill Surgery	Shipdham Surgery
E Harling & Kenninghall Medical Practice	Sole Bay H/C
East Norfolk Medical Practice	St Clements Surgery
East Norwich Medical Partnership	St James Medical Practice
Fakenham Medical Practice	St John's Surgery

Feltwell Surgery
Fleggburgh Surgery
Great Massingham Surgery
Grimston Medical Centre
Grove Surgery
Heacham Group Practice
Heathgate Medical Practice
Hellesdon Medical Practice
High Street Surgery
Hingham Surgery
Holt Medical Practice
Hoveton & Wroxham Medical Centre
Howdale Surgery
Humbleyard Practice
Kirkley Mill Health Centre
Lakenham Surgery
Lawns Practice
Lawson Road Surgery
Litcham Health Centre
Longshore Surgeries
Ludham and Stalham Green Surgeries
Magdalen Medical Practice
St Stephens Gate Medical Partnership
Stalham Staithe Surgery
Taverham Surgery
The Hollies Surgery
The Lionwood Medical Practice
The Millwood Partnership
The Park Surgery
Theatre Royal Surgery
Thorpewood Medical Group
Toftwood Medical Centre
Trinity & Bowthorpe Medical Practice
Upwell Health Centre
Victoria Road Surgery
Vida Healthcare
Watlington Medical Centre
Watton Medical Practice
Wells Health Centre
West Pottergate Med Prac
Windmill Surgery
Woodcock Rd Surgery
Wymondham Medical Partnership

General practices not included in the patient level dataset 2022-23 are:

Attleborough Surgery
Campingland Surgery
Church Hill Surgery
Elmham Surgery
Long Stratton Medical Partnership
Southgates Surgical & Medical Centre
UEA Medical Centre
Wensum Medical Practice
Blofield Surgery
Chet Valley Medical Practice
Drayton Medical Practice
Harleston Medical Practice
Paston Surgery
The Woottons Surgery
Vulnerable Adults Service

Appendix B) Technical report

Technical Appendix. Urgent and emergency health care activity in Norfolk, 2018-2023

Introduction

This appendix reports in detail on the research methods and results which are summarized in the main report, "What is the impact of COVID-19 on health services activity and associated health outcomes? Specifically, why is ED so busy?". Background to the study and discussion of the results are in the main report and not in this appendix.

Objectives

The purpose of the study was to describe and explain changes in NHS urgent and emergency care (UEC) in Norfolk and Waveney (N&W) between April 2018 and March 2023, which included periods before, during and after the three COVID lockdowns.

Specific objectives were to:

- Describe changes in the numbers of daily attendances to each of the three hospital ED departments in N&W, overall and for subgroups of patients, and in the time patients spent in the ED departments before discharge or admission to hospital
- Identify characteristics of all individuals living in N&W that were associated with attendances to ED from April 2022 to March 2023
- Describe changes in the numbers of daily telephone calls to NHS111 Clinical Assessment Service in N&W, and in the outcomes of those calls
- Describe changes in the numbers of daily ambulance callouts in N&W, and in the proportions of callouts with delayed handovers to each ED department

Study population and study design

The study outcomes were the indicators of UEC provided to this population, as defined above in objectives. The study design was an interrupted time series analysis of changes in urgent and emergency care (UEC) activity from April 2018 to March 2023, and cross-sectional analysis of individual person level predictors of ED attendances between April 2022 and March 2023.

Data sources

We used two databases provided by Norfolk and Waveney ICB, the ICB developmental linked patient level dataset 2022-23, and a database of health care activity including hospital trusts, the East of England Ambulance Service and NHS 111.

ICB developmental linked patient level dataset 2022-23

The cross-sectional analysis was carried out with N&W ICB's patient level dataset 2022-23. This contains data on individuals who were registered at a GP practice in N&W between 1st April 2022 and 31st March 2023. For the analysis, we only included individuals with an address within N&W. Of the 106 GP practices registered in Norfolk and Waveney [4], 91 are

included in the patient level dataset 2022-23 (see Appendix A) with 1,043,047 individuals recorded. Using weighted population estimates for 2022-23 for N&W ICB [5], this record covers approximately 90% of the N&W population. The patient level dataset 2022-23 combines data from each individual's general practice ('primary care' data) and from hospital trusts, together with age, sex and ethnicity, as well as indices of multiple deprivation (IMD) [6] decile based on the location of the individual's residential address. The primary care data included information on long-term medical conditions, and the number of general practice appointments during the year. Hospital data included the number of ED attendances made by the individual during the year. Distance from each individual's area of residence (census lower super output area centroid) to the nearest ED department was calculated.

Healthcare Activity Data

The time series analysis was carried out with health care activity data provided by N&W ICB, who collated data provided by NHS organisations including hospital trusts, the East of England Ambulance Service and NHS 111. We restricted our analyses of these data to individuals whose address was located in N&W or who were registered at a general practice located in N&W, and where activity took place between 1 April 2018 and 31 March 2023. Activity for patients who were neither registered with a GP practice nor had an address located within N&W but who attended hospitals within N&W 'out of area' were excluded. This particularly affects hospitals near county borders, for example QEH, which sees more 'out of area' patients. Similarly, activity at "out of area" hospitals (e.g. Peterborough City or West Suffolk Hospital) by patients residing in N&W was excluded.

For the analyses we focused on Type 1 emergency care department data (see 'Definitions' above) for the three major hospitals in Norfolk: NNUH, JPUH and QEH. Type 3 attendances in Norfolk and Waveney are predominantly from the Norwich Walk-in Centre at Rouen Road (excluded from analyses), the Minor Injuries Unit (MIU) in Cromer (included), and GP Front Door attendances (included). This report excludes analysis of attendances to hospital same day emergency care centres, and general practices.

For analysis on 'injury', and 'circulatory problems', we used the categories listed in the Emergency Care Data Set (ECDS) Technical Output Specification which maps SNOMED diagnoses to ICD-10 data [7].

Data from the ICB has also been supplied showing GP Front Door use at the three trusts between 17/12/2019 and 05/09/2023.

Statistical methods

We applied interrupted time series linear regression models [8] to explain the number of patients visited/average waiting time between arrivals and disposals/NHS 111 calls

received/ambulance calls per day in Norfolk and Waveney (N&W). In all models we adjusted for day of the week and month of the year to account for seasonal and within-week variation in activity. Model 1 is the simplest one that compares the average of pre-COVID and post-lockdown attendances/calls/waiting time per day. In Model 2, we also considered a continuous time trend from the start of the study to the end of pre-COVID period and from the start of the post-lockdown period to the end of the study. We also considered an interaction between the time trend and the indicator of pre-COVID and post-lockdown period, to estimated how the continuous time trend changed after lockdown period. In Model 3, we also considered indicator of three lockdown periods, to estimate the effect of each lockdown on UEC activity rates. For Models 1 & 2, we removed the observations during the period 26/03/20 to 29/03/2021.

The response variable of interest is the number of daily attendances and hence we calculated the number of daily attendances in each hospital and analyzed the day level aggregated data for each hospital separately. We carried out analyses for all attendances and subgroups based on arrival mode and diagnosis of disease. To estimate absolute change in mean daily attendances during post-lockdown compared with pre-lockdown period, we used the following linear regression model:

Model 1: $$Y_t = \beta_0 + \beta_1 P + \boldsymbol{\beta}_{5-10}^{\top}\boldsymbol{W} + \boldsymbol{\beta}_{11-21}^{\top}\boldsymbol{M} + \epsilon.$$

Where Y_t is the daily hospital attendances, β_0 is the average daily attendances during pre-COVID period, β_1 is the change in mean daily attendances in the post-lockdown period compared to pre-COVID period, P is the binary variable representing pre-COVID and post-lockdown periods, $\boldsymbol{W} = (W_1, \dots, W_6)^{\top}$ is the set of dummy variables representing days of the week and $\beta_5, \dots, \beta_{10}$ are their corresponding regression coefficients, $\boldsymbol{M} = (M_1, \dots, M_{11})^{\top}$ is the vector of indicator variables that represents the months of the year and $\beta_{11}, \dots, \beta_{21}$ are the corresponding regression coefficients and ϵ is the random error term.

To estimate the continuous time trend during pre-COVID and post-lockdown periods as well as the step change at the start of post-lockdown period compared to the start of study period, we used the following linear regression model:

Model 2: $$Y_t = \beta_0 + \beta_1 P + \beta_2 T + \beta_3 PT + \boldsymbol{\beta}_{5-10}^{\top}\boldsymbol{W} + \boldsymbol{\beta}_{11-21}^{\top}\boldsymbol{M} + \epsilon.$$

Where Y_t, $\boldsymbol{W}$, $\boldsymbol{M}$, $\boldsymbol{\beta}_{5-10}$ and $\boldsymbol{\beta}_{11-2}$ are same as Model 1, β_0 is the mean daily attendances at the start of study period, $\beta_1$is the change in mean daily attendances at the start of post-lockdown period compared to start of study period, P is same as Model 1, β_2 is the average change per day in daily hospital attendances during pre-COVID period, T represents the number of days from the start of study period during pre-COVID period or the number of days after lockdown, PT is the interaction between indicator of pre-COVID and post-lockdown

periods and time, β_3 is the average change per day in daily attendances in addition to β_1 in post-lockdown period ($\beta_1 + \beta_3$ is the average change per day in daily attendances during post-lockdown period). The daily average waiting time between arrival and departure in NNUH during post-lockdown period is not linear, hence we employed a second-degree polynomial regression model (extended version of Model 2). The regression model used for average waiting time in NNUH is:

Model 2(a): $$Y_t = \beta_0 + \beta_1 P + \beta_2 T + \beta_3 PT + \beta_4 PT^2 + \boldsymbol{\beta}_{5-10}^{\top}\boldsymbol{W} + \boldsymbol{\beta}_{11-21}^{\top}\boldsymbol{M} + \epsilon.$$

The regression equation to estimate the absolute change at the start of post-lockdown, continuous time trend from the start of study period and step changes in each lockdown compared to pre-lockdown period was as follows:

Model 3: $$Y_t = \beta_0 + \beta_{31} P_3 + \beta_{32} T_3 + \beta_{33} P_3 T_3 + \boldsymbol{\beta}_{5-10}^{\top}\boldsymbol{W} + \boldsymbol{\beta}_{11-21}^{\top}\boldsymbol{M} + \beta_{22} L_1 + \beta_{23} L_2 + \beta_{24} L_3 + \epsilon.$$

Where Y_t, $\boldsymbol{W}$, $\boldsymbol{M}$, β_0, $\boldsymbol{\beta}_{5-10}$ and $\boldsymbol{\beta}_{11-21}$ are same as Model 2, β_{31} is the change in average daily attendances immediately after end of lockdown period compared to start of study period, P_3 is the binary variable representing the post-lockdown period and remaining study period, β_{32} is the average change per day in daily attendances before post-lockdown period, T_3 is the continuous time trend from the start of study period, β_{33} is the additional average change per day in daily attendances during post-lockdown period compared to remaining time, $P_3 T_3$ is the interaction between dummy of pre-COVID and post-lockdown periods and time, L_1, L_2 and L_3 are binary dummy variables indicating the stages of lockdown, and the coefficients β_{22}, β_{23} and β_{24} represents the mean differences of daily attendances from the mean of pre-COVID period.

For analysing the patient level dataset 2022-23, we employed Poisson regression model to identify the factors responsible for the number of ED attendances each person made during one year, which was the outcome of this analysis.

Let Y_i be the number of attendances made by the ith individual with mean $\mu_i > 0$. If $Y_i \sim Poisson(\mu_i)$ ($i = 1, 2, \dots, n$) then the probability mass function of Y_i is [2])

$$P(Y_i = y_i; \mu_i) = \frac{e^{-\mu_i}\mu_i^{y_i}}{y_i!}; y_i = 0, 1, 2, \dots$$

In Poisson distribution, the mean of Y_i is equal to its variance, i.e., $E(Y_i) = var(Y_i) = \mu_i$. In the generalized linear model framework, the mean μ_i is functionally related with the linear predictors and that function is called the link function. Let $\boldsymbol{x}_i = (1, x_{i1}, x_{i2}, \dots, x_{ik})^{\top}$is a $p \times 1$ vector of covariates ($p = k + 1$) for the ith individual and $\boldsymbol{\beta} = (\beta_0, \beta_1, \beta_2, \dots, \beta_k)^{\top}$ is a $p \times 1$ vector of regression parameters then for Poisson regression model $\log(\mu_i) = \boldsymbol{x}_i^{\top}\boldsymbol{\beta}$ or $\mu_i =$

$\exp(\boldsymbol{x}_i^{\top}\boldsymbol{\beta})$ [1, 2]. The link-function used here is called the log-link or inverse function.
In all Poisson regression models, we included age, sex, ethnicity, index of multiple deprivation (IMD), distance to nearest ED department, and distance squared, as covariates. Distance squared was included because health care utilisation rates commonly have an exponential (non-linear) relationship with distance to care. We used five Poisson regression models:

- Model 1 included these variables only, with IMD decile coded as a continuous variable, so that the incidence rate ratio (IRR) for IMD is for a difference of one IMD decile. The most deprived decile was coded as 1 and the least deprived decile was coded as 10. Model 1 (a) was identical to Model 1 except that IMD deciles were coded as factor variables, with each decile compared to the most deprived decile as reference category.
- Model 2 included all the covariates used in Model 1, and also the number of long term conditions each individual was recorded as having.
- Model 3 included all the covariates used in Model 1, and also nine specific types of long term condition each individual was recorded as having or not.
- Model 4 included all the covariates used in Model 3, and also the number of primary care appointments attended during the year.

[1] J. M. Hilbe, *Negative binomial regression*, 2nd ed. Cambridge University Press, 2011.
[2] F. Suryadi, S. Jonathan, K. Jonatan, and M. Ohyver, "Handling overdispersion in poisson regression using negative binomial regression for poverty case in west java," *Procedia Computer Science,* vol. 216, pp. 517-523, 2023.

Results

This section provides detailed results of the statistical analyses in the following order:

- Emergency department attendances
    - Changes in daily numbers of attendances to each ED department:
        - all attendances
        - attendances arriving by ambulance
        - attendances arriving not by ambulance
        - attendances by patients with injuries
        - attendances by patients diagnosed with circulatory (cardiovascular) conditions
        - attendances by patients referred by primary health care teams
        - attendances by patients referred by NHS 111
    - Changes in waiting time between arrival at and departure from ED
    - Changes in daily numbers of minor injury unit attendances
    - Individual level predictors of ED attendances during one year
- Changes in daily numbers and outcomes of NHS 111 telephone calls
- Changes in ambulance callouts
    - Daily numbers of daily callouts
    - Proportions of callouts with delayed handover to ED departments

Interpretation of the values of regression analyses

Results of analyses of these changes, according to regression models 1, 2 and 3, are reported in the same general format, which we explain here to facilitate interpretation of the tables and graphs. We will use the example of analysis of total daily attendances to NNUH ED department reported in detail in Table 1 below and graphed in Figure 14. Figure 14 is a scatter graph of the numbers of daily attendances to NNUH ED together with the time trend lines fitted to these data using regression models 1 and 2. These fitted lines correspond with the coefficients reported for NNUH in Tables 2 and 3, which explains and illustrates how to interpret these results throughout the report.

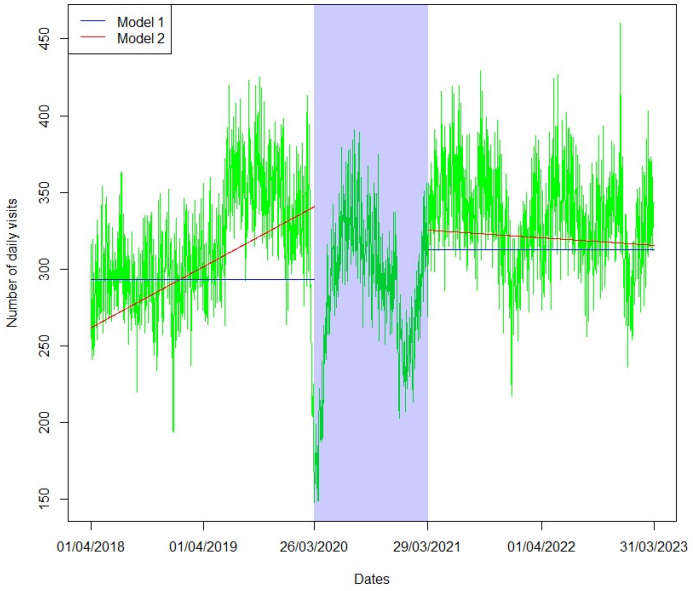
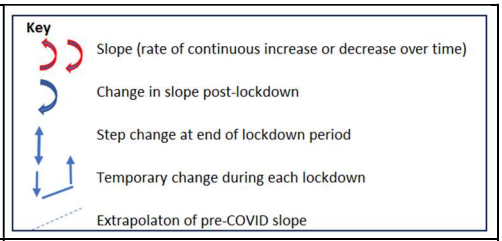
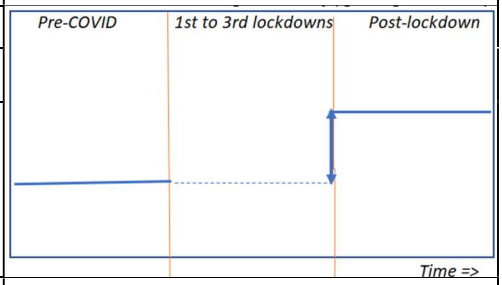
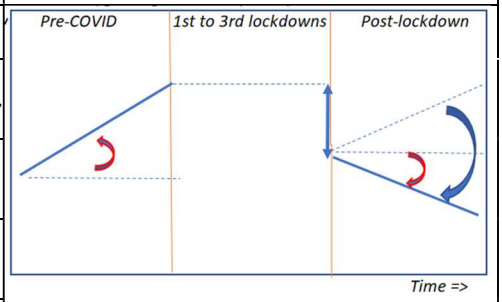
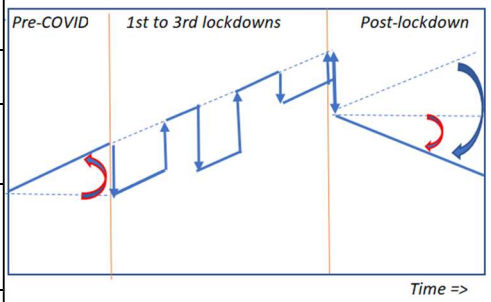


Figure 14: Total number of daily ED attendances in NNUH

Table 2. Interpretation of regression model results (using example of NNUH results in Table 3 and Figure 14)

Models and variables	Coefficient	Interpretation	
Model 1			
Intercept	293.4	Mean daily attendances pre-COVID	
Post-lockdown vs pre-CODID	19.1	Difference in mean daily attendances post-lockdown compared to pre-COVID	
Model 2			
Intercept	261.6	Mean daily attendances at start of study period	
Time trend	0.109	Average change per day in daily attendances during pre-COVID period (i.e., slope)	
Post-lockdown vs pre-COVID	63.7	Difference in mean daily attendances at start of post- lockdown period compared to start of study period	
Days*post-lockdown interaction	-0.122	Change in slope (i.e., average change per day in daily attendances) from pre-COVID period to post-lockdown period	
Difference between start of post-lockdown and end of pre-COVID	*-15.3*	Calculated step change difference between daily attendances at start of post-lockdown period and end of pre-COVID period = [post-lockdown vs pre-COVID difference] - [no. days pre-COVID x pre-COVID time trend] = 63.7 – (725 x 0.109)	
Post pandemic trend (change per year)	-4.9	Calculated average change per year in daily attendances during post-lockdown period = [(change per day pre-COVID) + (change in slope)] x 365 days = ((0.109) + (-0.122)) x 365	
Model 3			
Intercept	268.9	Mean daily attendances at start of study period	
Days since 1/4/2018	0.041	Average change per day in daily attendances before post-lockdown period	
Post-lockdown period vs remaining time	68.0	Step change in daily attendances immediately after end of lockdown period	
Days*post-lockdown interaction	-0.061	Change in slope (i.e., average change per day in daily attendances) in post-lockdown period compared to remaining time	
1st lockdown	-64.8	Temporary change in mean daily attendances during 1st lockdown	
2nd lockdown	-51.1	Temporary change in mean daily attendances during 2nd lockdown	
3rd lockdown	-53.5	Temporary change in mean daily attendances during 3rd lockdown	

Emergency department attendances

- **Selection of attendances:** We selected those attendances where the patients were either registered to 105 general practices (GP) in Norfolk and Waveney (N&W) or had home address in N&W (611 Lower Super Output Area (LSOA)) and visited three major hospitals (Main 24Hr ED) such as Norfolk and Norwich University Hospital (NNUH), James Paget University Hospital (JPUH) and Queen Elizabeth Hospital (QEH) from 1 April 2018 to 31 March 2023. The above selection criteria reduce the number of attendances to 1193359. Among them, around half (48.4%, 578174) were visited to NNUH, and 29.2% (n=348702) and 22.3% (n=266483) were visited to JPUH and QEH respectively.
- Of all attendances, 48.1% (n=574417) were male and 51.9% (n=618888) were female whereas 54 attendances had unspecified gender.
- Of the visited patients, 34.1% (n=406976) were arrived by ambulance including helicopter and air ambulance. More than half of the ambulance reached to NNUH (53.3%, n=217039) and 26.1% (n=106063) and 20.6% (n=83874) ambulance reached to JPUH and QEH respectively.
- Almost all (98.5%, n=1174996) patients were visited for first AE and the remaining were visited for follow-up (planned or unplanned).
- Of the visited patients, 83.6% (n=997577) were British and 10.8% (n=128788) had other white background. The most common causes of ED attendances were injury (29.5%, n=352363), respiratory diseases (8.6%, n=103167), circulatory problems (8.1%, n=96174) and digestive system problems (6.6%, n=78860).
- Around half (48.4%, n=577652) attendances were self-referred to ED department, 27.0% (n=322778) were referred by ambulance service, 8.8% (n=104624) were referred by primary care health team and 7.8% (n=92646) were referred by NHS 111 service.

Results of the regression analyses follow on the next page. Pages henceforth are in landscape format to accommodate the wide tables.

Changes in daily numbers of all attendances to each ED department

*Table 3: Coefficient, 95% CI and p-value of linear regression model for **all AE attendances** in NNUH, JPUH and QEH (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	293.4	(286.0, 300.8)	<0.001	184.8	(179.7, 189.8)	<0.001	136.3	(132.8, 139.9)	<0.001
Post-lockdown vs pre-COVID	19.1	(15.7, 22.5)	<0.001	9.0	(6.6, 11.3)	<0.001	14.9	(13.2, 16.5)	<0.001
Model 2									
Intercept	261.6	(254.4, 268.8)	<0.001	169.8	(164.5, 175.1)	<0.001	132.3	(128.5, 136.2)	<0.001
Time trend	0.109	(0.098, 0.120)	<0.001	0.049	(0.041, 0.057)	<0.001	0.010	(0.005, 0.016)	<0.001
Post-lockdown vs pre-COVID	63.7	(57.7, 69.7)	<0.001	32.1	(27.6, 36.5)	<0.001	23.2	(20.0, 26.5)	<0.001
Days*post-lockdown interaction	-0.122	(-0.137, -0.108)	<0.001	-0.063	(-0.074, -0.053)	<0.001	-0.023	(-0.031, -0.015)	<0.001
Difference between start of post-lockdown and end of pre-COVID	*-15.3*	*(-21.9, -8.7)*	*<0.001*	*-3.5*	*(-8.4, 1.4)*	*0.16*	*15.6*	*(12.1, 19.2)*	<0.001
Post-lockdown trend (change per year)	*-4.9*	*(-8.8, -1.0)*	*0.014*	*-5.3*	*(-8.2, -2.4)*	*<0.001*	*-4.5*	*(-6.7, -2.4)*	*<0.001*
Model 3									
Intercept	268.9	(261.7, 276.2)	<0.001	173.6	(168.6, 178.7)	<0.001	132.7	(129.1, 136.3)	<0.001
Days since 1/4/2018	0.041	(0.033, 0.049)	<0.001	0.012	(0.007, 0.018)	<0.001	-0.001	(-0.005, 0.003)	0.53
Post-lockdown vs remaining time	68.0	(50.3, 85.6)	<0.001	42.1	(29.8, 54.4)	<0.001	34.4	(25.6, 43.2)	<0.001
Days*post-lockdown interaction	-0.061	(-0.075, -0.047)	<0.001	-0.030	(-0.040, -0.021)	<0.001	-0.012	(-0.019, -0.005)	0.0007
1st lockdown	-64.8	(-72.8, -56.8)	<0.001	-47.9	(-53.5, -42.3)	<0.001	-32.8	(-36.8, -28.8)	<0.001
2nd lockdown	-51.1	(-64.9, -37.3)	<0.001	-29.0	(-38.7, -19.4)	<0.001	-12.9	(-19.8, -6.0)	<0.001
3rd lockdown	-53.5	(-62.7, -44.4)	<0.001	-35.6	(-41.9, -29.2)	<0.001	-17.1	(-21.7, -12.6)	<0.001

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- There was a significant increase in the average number of attendances per day during post-lockdown for all ED attendances in all three hospitals (NNUH: 19.1, 95% CI 15.7 to 22.5; JPUH: 9.0, 95% CI 6.6 to 11.3; QEH: 14.9, 95% CI 13.2 to 16.5). The highest percentage of increase was observed in QEH.

Model 2:

- Significant increase was observed per day in daily attendances during pre-COVID period in all three hospitals.
- There was a step increase of approximately 64 daily attendances at the start of the post-COVID compared to the start of the study period in NNUH (63.7, 95% CI 57.7 to 69.7) and in JPUH and QEH average number of attendances increased by about 32 and 23 patients respectively (JPUH: 32.1, 95% CI 27.6 to 36.5; QEH: 23.2, 95% CI 20.0 to 26.5).
- During post-lockdown period, yearly attendances decreased significantly with an approximately equal number of attendances in all three hospitals (NNUH: -4.9, 95% CI -8.8 to -1.0; JPUH: -5.3, 95% CI -8.2 to -2.4; QEH: -4.5, 95% CI -6.7 to -2.4).

Changes in daily number of ED attendances arriving by ambulance

*Table 4: Coefficient, 95% CI and p-value of linear regression model for patients **arriving by ambulance** in NNUH, JPUH and QEH (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	132.8	(129.5, 136.0)	<0.001	63.0	(61.1, 65.0)	<0.001	46.4	(44.8, 47.9)	<0.001
Post-lockdown vs pre-COVID	-22.0	(-23.4, -20.5)	<0.001	-6.4	(-7.3, -5.5)	<0.001	-1.1	(-1.8, -0.4)	0.002
Model 2									
Intercept	126.0	(123.2, 128.8)	<0.001	61.0	(59.0, 62.9)	<0.001	44.7	(43.1, 46.2)	<0.001
Time trend	0.006	(0.002, 0.010)	0.006	-0.0001	(-0.003, 0.003)	0.93	0.001	(-0.001, 0.003)	0.42
Post-lockdown vs pre-COVID	3.0	(0.7, 5.3)	0.012	3.0	(1.4, 4.6)	<0.001	5.7	(4.4, 7.0)	<0.001
Days*post-lockdown interaction	-0.068	(-0.074, -0.063)	<0.001	-0.026	(-0.030, -0.022)	<0.001	-0.018	(-0.022, -0.015)	<0.001
Difference between start of post-lockdown and end of pre-COVID	*-1.3*	*(-3.9, 1.2)*	*0.31*	*3.1*	*(1.3, 4.9)*	*0.00059*	*5.0*	*(3.5, 6.4)*	*<0.001*
Post-lockdown trend (change per year)	*-22.7*	*(-24.2, -21.2)*	*<0.001*	*-9.5*	*(-10.5, -8.4)*	*<0.001*	*-6.4*	*(-7.2, -5.5)*	*<0.001*
Model 3									
Intercept	121.1	(118.6, 123.7)	<0.001	59.4	(57.6, 61.1)	<0.001	43.2	(41.8, 44.7)	<0.001
Days since 1/4/2018	0.012	(0.009, 0.015)	<0.001	-0.001	(-0.003, 0.001)	0.43	0.005	(0.003, 0.007)	<0.001
Post-lockdown vs remaining time	71.1	(64.8, 77.4)	<0.001	30.8	(26.5, 35.1)	<0.001	25.0	(21.5, 28.6)	<0.001
Days*post-lockdown interaction	-0.073	(-0.078, -0.068)	<0.001	-0.025	(-0.028, -0.022)	<0.001	-0.022	(-0.025, -0.019)	<0.001
1st lockdown	-14.9	(-17.8, -12.1)	<0.001	-4.4	(-6.3, -2.5)	<0.001	-5.2	(-6.8, -3.6)	<0.001
2nd lockdown	-6.2	(-11.2, -1.3)	0.013	-5.0	(-8.3, -1.6)	0.003	-1.2	(-4.0, 1.6)	0.40
3rd lockdown	-6.9	(-10.2, -3.6)	<0.001	-2.4	(-4.7, -0.2)	0.03	-3.1	(-4.9, -1.2)	0.00101

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- There was a significant decrease in the daily average number of attendances for patients arriving by ambulance in post-lockdown period compared to pre-COVID period in all 3 hospitals with biggest decrease observed in NNUH (NNUH: -22.0, 95% CI -23.4 to -20.5; JPUH: -6.4, 95% CI -7.3 to -5.5; QEH: -1.1, 95% CI -1.8 to -0.4).

Model 2:

- There was a significant increase per day in daily attendances in NNUH during pre-COVID period. In other two hospitals, average daily attendances remained level off during that period.
- A significant increase was observed in mean daily attendances immediately after post-lockdown compared to start of study period in all 3 hospitals with highest increase in QEH (NNUH: 3.0, 95% CI 0.7 to 5.3; JPUH: 3.0, 95% CI 1.4 to 4.6; QEH: 5.7, 95% CI 4.4 to 7.0).
- Significant rate of decrease per year was observed during post-lockdown period in all 3 hospitals with biggest rate of decrease in NNUH (NNUH: -22.7, 95% CI -24.2 to -21.2; JPUH: -9.5, 95% CI -10.5 to -8.4; QEH: -6.4, 95% CI -7.2 to -5.5).

Changes in daily number of ED attendances arriving not by ambulance

*Table 5: Coefficient, 95% CI and p-value of linear regression model for patients **arriving not by ambulance** in NNUH, JPUH and QEH (adjusted for day of week and month)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	160.6	(153.9, 167.3)	<0.001	121.7	(117.2, 126.3)	<0.001	89.9	(86.8, 93.1)	<0.001
Post-lockdown vs pre-COVID	41.1	(38.0, 44.2)	<0.001	15.4	(13.3, 17.4)	<0.001	16.0	(14.5, 17.4)	<0.001
Model 2									
Intercept	135.6	(129.3, 142.0)	<0.001	108.9	(104.1, 113.6)	<0.001	87.7	(84.2, 91.1)	<0.001
Time trend	0.103	(0.093, 0.113)	<0.001	0.049	(0.042, 0.056)	<0.001	0.010	(0.004, 0.015)	<0.001
Post-lockdown vs pre-COVID	60.7	(55.4, 66.0)	<0.001	29.0	(25.1, 33.0)	<0.001	17.6	(14.7, 20.4)	<0.001
Days*post-lockdown interaction	-0.054	(-0.067, -0.042)	<0.001	-0.038	(-0.047, -0.028)	<0.001	-0.004	(-0.011, 0.002)	0.20
Difference between start of post-lockdown and end of pre-COVID	*-14.0*	*(-19.8, -8.1)*	*<0.001*	*-6.6*	*(-11.0, -2.2)*	*<0.001*	*10.7*	*(7.5, 13.9)*	*<0.001*
Post-lockdown trend (change per year)	*17.8*	*(14.4, 21.3)*	*<0.001*	*4.2*	*(1.6, 6.8)*	*0.002*	*1.8*	*(-0.03, 3.72)*	*0.054*
Model 3									
Intercept	147.8	(141.4, 154.2)	<0.001	114.3	(109.8, 118.7)	<0.001	89.5	(86.4, 92.7)	<0.001
Days since 1/4/2018	0.029	(0.022, 0.036)	<0.001	0.013	(0.008, 0.018)	<0.001	-0.006	(-0.010, -0.003)	<0.001
Post-lockdown vs remaining time	-3.1	(-18.9, 12.6)	0.70	11.3	(0.4, 22.2)	0.04	9.4	(1.6, 17.1)	0.02
Days*post-lockdown interaction	0.012	(-0.0001, 0.024)	0.052	-0.005	(-0.014, 0.003)	0.21	0.010	(0.004, 0.016)	0.00104
1st lockdown	-49.9	(-57.0, -42.7)	<0.001	-43.5	(-48.4, -38.6)	<0.001	-27.6	(-31.1, -24.1)	<0.001
2nd lockdown	-44.9	(-57.2, -32.5)	<0.001	-24.0	(-32.6, -15.5)	<0.001	-11.7	(-17.8, -5.6)	<0.001
3rd lockdown	-46.6	(-54.8, -38.5)	<0.001	-33.1	(-38.8, -27.5)	<0.001	-14.1	(-18.1, -10.0)	<0.001

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- The average of daily attendances increased by 41.1, 15.4 and 16.0 patients during post-lockdown period compared to pre-COVID period for patients arriving not by ambulance in NNUH (95% CI 38.0 to 44.2), JPUH (95% CI 13.3 to 17.4) and QEH (95% CI 14.5 to 17.4), respectively. The highest rate of increase was observed in NNUH.

Model 2:

- There was a significant increase per day in daily attendances for patients arriving not by ambulance in all three hospitals during pre-COVID period.
- A huge increase in average daily attendances was observed immediately after lockdown compared to start of study period in all three hospitals (NNUH: 60.7, 95% CI 55.4 to 66.0; JPUH: 29.0, 95% CI 25.1 to 33.0; QEH: 17.6, 95% CI 14.7 to 20.4).
- There was a significant increase in daily attendances per year during post-lockdown period in NNUH and JPUH (NNUH: 17.8, 95% CI 14.4 to 21.3; JPUH: 4.2, 95% CI 1.6 to 6.8) while no significant change was observed in QEH. Among the three hospitals, the biggest increase was found in NNUH.

Changes in daily number of ED attendances by patients with injuries

*Table 6: Coefficient, 95% CI and p-value of linear regression model for **injury** patients in NNUH, JPUH and QEH (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	88.8	(85.5, 92.2)	<0.001	55.1	(52.7, 57.4)	<0.001	40.8	(39.1, 42.6)	<0.001
Post-lockdown vs pre-COVID	5.4	(3.9, 7.0)	<0.001	1.2	(0.2, 2.3)	0.02	3.1	(2.3, 3.9)	<0.001
Model 2									
Intercept	87.7	(84.2, 91.2)	<0.001	49.5	(47.0, 51.9)	<0.001	40.0	(38.1, 42.0)	<0.001
Time trend	0.013	(0.008, 0.019)	<0.001	0.015	(0.011, 0.019)	<0.001	0.004	(0.001, 0.006)	0.02
Post-lockdown vs pre-COVID	-1.7	(-4.6, 1.2)	0.26	12.8	(10.8, 14.8)	<0.001	3.5	(1.9, 5.1)	<0.001
Days*post-lockdown interaction	0.019	(0.012, 0.026)	<0.001	-0.032	(-0.036, -0.027)	<0.001	-0.001	(-0.005, 0.003)	0.54
Difference between start of post-lockdown and end of pre-COVID	*-11.4*	*(-14.7, -8.2)*	*<0.001*	*1.8*	*(-0.4, 4.0)*	*0.11*	*0.9*	*(-0.8, 2.7)*	*0.30*
Post-lockdown trend (change per year)	*12.0*	*(10.1, 13.9)*	*<0.001*	*-6.0*	*(-7.3, -4.7)*	*<0.001*	*0.8*	*(-0.2, 1.9)*	*0.12*
Model 3									
Intercept	89.0	(85.8, 92.2)	<0.001	50.1	(47.9, 52.4)	<0.001	39.6	(37.8, 41.3)	<0.001
Days since 1/4/2018	-0.001	(-0.005, 0.002)	0.48	0.004	(0.002, 0.007)	0.0007	0.00048	(-0.001, 0.002)	0.63
Post-lockdown vs remaining time	-39.6	(-47.5, -31.8)	<0.001	29.2	(23.7, 34.7)	<0.001	0.4	(-3.8, 4.7)	0.84
Days*post-lockdown interaction	0.033	(0.027, 0.039)	<0.001	-0.022	(-0.026, -0.018)	<0.001	0.002	(-0.002, 0.005)	0.34
1st lockdown	-26.5	(-30.1, -23.0)	<0.001	-20.8	(-23.3, -18.4)	<0.001	-13.7	(-15.7, -11.8)	<0.001
2nd lockdown	-6.6	(-12.7, -0.5)	0.04	-11.5	(-15.8, -7.2)	<0.001	-2.8	(-6.1, 0.6)	0.11
3rd lockdown	-8.8	(-12.8, -4.7)	<0.001	-13.4	(-16.2, -10.5)	<0.001	-5.1	(-7.3, -2.9)	<0.001

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- The average daily attendances increased significantly for injury patients in post-lockdown period as compared to pre-COVID period in all three hospitals (NNUH: 5.4, 95% CI 3.9 to 7.0; JPUH: 1.2, 95% CI 0.2 to 2.3; QEH: 3.1, 95% 2.3 to 3.9). The biggest percentage of increase was observed in QEH.

Model 2:

- Significant increase per day was observed in daily attendances of injury patients during pre-COVID period in all three hospitals.

- As compared to start of study period, a significant increase in average daily attendances was observed at start of post-lockdown in both JPUH (12.8, 95% CI 10.8 to 14.8) and QEH (3.5, 95% CI 1.9 to 5.1). However, there was no significant change in NNUH.
- During post-lockdown period, there was a significant increase per year in daily attendances in NNUH (12.0, 95% CI 10.1 to 13.9) and a significant decrease in JPUH (-6.0, 95% CI -7.3 to -4.7). The QEH remained level off.

Changes in daily number of ED attendances by patients with circulatory problems

*Table 7: Coefficient, 95% CI and p-value of linear regression model for patients suffering from **circulatory problem** in NNUH, JPUH and QEH (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	27.0	(25.7, 28.3)	<0.001	11.4	(10.6, 12.2)	<0.001	12.8	(11.8, 13.7)	<0.001
Post-lockdown vs pre-COVID	2.3	(1.8, 2.9)	<0.001	0.4	(0.024, 0.8)	0.04	4.7	(4.3, 5.1)	<0.001
Model 2									
Intercept	24.3	(22.9, 25.6)	<0.001	11.7	(10.8, 12.6)	<0.001	12.4	(11.4, 13.5)	<0.001
Time trend	0.008	(0.006, 0.010)	<0.001	-0.001	(-0.003, -0.0001)	0.03	0.002	(0.0004, 0.004)	0.02
Post-lockdown vs pre-COVID	7.5	(6.4, 8.6)	<0.001	0.3	(-0.4, 1.0)	0.43	4.5	(3.6, 5.3)	<0.001
Days*post-lockdown interaction	-0.014	(-0.017, -0.011)	<0.001	0.0003	(-0.001, 0.002)	0.76	0.001	(-0.001, 0.003)	0.59
Difference between start of post-lockdown and end of pre-COVID	*1.9*	*(0.6, 3.1)*	*0.004*	*1.3*	*(0.5, 2.2)*	*0.0012*	*3.1*	*(2.1, 4.0)*	*<0.001*
Post-lockdown trend (change per year)	*-2.3*	*(-3.1, -1.6)*	*<0.001*	*-0.4*	*(-0.9, 0.05)*	*0.08*	*0.9*	*(0.3, 1.5)*	*0.002*
Model 3									
Intercept	23.3	(22.0, 24.5)	<0.001	11.5	(10.7, 12.3)	<0.001	11.4	(10.5, 12.3)	<0.001
Days since 1/4/2018	0.007	(0.006, 0.008)	<0.001	-0.003	(-0.003, -0.002)	<0.001	0.003	(0.002, 0.004)	<0.001
Post-lockdown vs remaining time	14.3	(11.3, 17.4)	<0.001	1.4	(-0.5, 3.3)	0.16	1.9	(-0.4, 4.2)	0.10
Days*post-lockdown interaction	-0.013	(-0.016, -0.011)	<0.001	0.001	(-0.0002, 0.003)	0.09	-0.001	(-0.003, 0.001)	0.41
1st lockdown	-3.5	(-4.9, -2.1)	<0.001	0.5	(-0.4, 1.4)	0.27	-2.9	(-4.0, -1.9)	<0.001
2nd lockdown	0.5	(-2.0, 2.9)	0.70	-1.3	(-2.8, 0.2)	0.10	0.8	(-1.0, 2.6)	0.37
3rd lockdown	-3.2	(-4.8, -1.6)	<0.001	-0.1	(-1.1, 0.9)	0.87	-2.1	(-3.3, -0.9)	<0.001

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- As compared to pre-COVID period, average daily attendances of patients with circulatory problem were increased slightly during post-lockdown period in NNUH (2.3, 95% CI 1.8 to 2.9) and increased substantially in QEH (4.7, 95% CI 4.3 to 5.1), while in JPUH mean daily attendances remained almost constant.

Model 2:

- There was a significant increase per day in daily attendances in both NNUH and QEH and decrease in JPUH for patients with circulatory problem during pre-COVID period.
- A big increase in average daily number of patients visited with circulatory problem was observed immediately after lockdown as compared to start of study period in NNUH (7.5, 95% CI 6.4 to 8.6) and QEH (4.5, 95% CI 3.6 to 5.3), no significant change was discovered in JPUH.
- There was a significant decrease in daily attendances per year with circulatory problem in NNUH (-2.3, 95% CI -3.1 to -1.6) and significant increase in QEH (0.9, 95% CI 0.3 to 1.5) while JPUH remained level off.

Changes in daily number of ED attendances by patients referred by primary health care teams

*Table 8: Coefficient, 95% CI and p-value of linear regression model for patients **referred by primary health care team** in NNUH, JPUH and QEH (adjusted for day of week and month)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	37.8	(35.1, 40.6)	<0.001	7.5	(6.6, 8.4)	<0.001	19.1	(17.7, 20.5)	<0.001
Post-lockdown vs pre-COVID	14.0	(12.8, 15.3)	<0.001	-1.7	(-2.1, -1.3)	<0.001	-0.5	(-1.1, 0.2)	0.14
Model 2									
Intercept	27.7	(25.0, 30.5)	<0.001	9.2	(8.3, 10.2)	<0.001	20.4	(19.0, 21.9)	<0.001
Time trend	0.036	(0.032, 0.040)	<0.001	-0.004	(-0.005, -0.003)	<0.001	-0.003	(-0.005, -0.0004)	0.02
Post-lockdown vs pre-COVID	26.9	(24.7, 29.2)	<0.001	-5.7	(-6.5, -4.9)	<0.001	-4.1	(-5.3, -2.8)	<0.001
Days*post-lockdown interaction	-0.036	(-0.041, -0.030)	<0.001	0.011	(0.009, 0.013)	<0.001	0.010	(0.007, 0.013)	<0.001
Difference between start of post-lockdown and end of pre-COVID	*0.7*	*(-1.8, 3.2)*	*0.58*	*-2.7*	*(-3.6, -1.9)*	*<0.001*	*-2.1*	*(-3.5, -0.7)*	*0.003*
Post-lockdown trend (change per year)	*0.2*	*(-1.3, 1.7)*	*0.76*	*2.5*	*(2.0, 3.0)*	*<0.001*	*2.6*	*(1.8, 3.4)*	*<0.001*
Model 3									
Intercept	30.0	(27.5, 32.5)	<0.001	9.3	(8.5, 10.1)	<0.001	20.2	(18.9, 21.5)	<0.001
Days since 1/4/2018	0.019	(0.017, 0.022)	<0.001	-0.005	(-0.006, -0.004)	<0.001	-0.005	(-0.006, -0.003)	<0.001
Post-lockdown vs remaining time	23.4	(17.3, 29.6)	<0.001	-13.2	(-15.2, -11.2)	<0.001	-12.3	(-15.6, -9.0)	<0.001
Days*post-lockdown interaction	-0.020	(-0.025, -0.015)	<0.001	0.012	(0.010, 0.013)	<0.001	0.012	(0.009, 0.014)	<0.001
1st lockdown	-5.5	(-8.3, -2.8)	<0.001	-0.6	(-1.6, 0.3)	0.17	-0.8	(-2.3, 0.7)	0.30
2nd lockdown	-9.8	(-14.6, -5.0)	<0.001	0.2	(-1.3, 1.7)	0.80	-2.1	(-4.7, 0.4)	0.10
3rd lockdown	-9.2	(-12.4, -6.0)	<0.001	-0.5	(-1.6, 0.5)	0.34	-2.7	(-4.4, -1.0)	0.002

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- A significant increase was observed in average daily attendances of patients referred by PHCT during post-lockdown period compared to pre-COVID period in NNUH (14.0, 95% CI 12.8 to 15.3) while a significant decrease was found in JPUH (-1.7, 95% CI -2.1 to -1.3).

Model 2:

- Significant increase per day in daily attendances was observed for patients referred by PHCT during pre-COVID period in NNUH, while significant decrease was found in JPUH and QEH.
- As compared to start of study period, there was a substantial increase in average daily number of patients visited who were referred by PHCT immediately after lockdown in NNUH (26.9, 95% CI 24.7 to 29.2) but significant decrease was discovered in both JPUH and QEH (JPUH: -5.7, 95% CI -6.5 to -4.9; QEH: -4.1, 95% CI -5.3 to -2.8).
- Patients referred by PHCT were increased by 2.5 and 2.6 attendances per year during post-COVID period in JPUH and QEH, respectively (JPUH: 95% CI 2.0 to 3.0; QEH: 95% CI 1.8 to 3.4). However, no significant change was observed in NNUH.

Changes in daily number of ED attendances by patients referred by NHS111

*Table 9: Coefficient, 95% CI and p-value of linear regression model for patients **referred by NHS111** in NNUH, JPUH and QEH (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	26.1	(24.3, 28.0)	<0.001	4.9	(4.1, 5.6)	<0.001	12.0	(10.9, 13.1)	<0.001
Post-lockdown vs pre-COVID	-5.3	(-6.2, -4.5)	<0.001	2.7	(2.4, 3.1)	<0.001	-3.7	(-4.2, -3.2)	<0.001
Model 2									
Intercept	19.5	(17.7, 21.3)	<0.001	4.5	(3.6, 5.4)	<0.001	13.6	(12.4, 14.7)	<0.001
Time trend	0.025	(0.023, 0.028)	<0.001	0.001	(-0.0005, 0.002)	0.20	-0.007	(-0.009, -0.006)	<0.001
Post-lockdown vs pre-COVID	1.7	(0.2, 3.2)	0.03	3.6	(2.8, 4.3)	<0.001	-4.2	(-5.2, -3.3)	<0.001
Days*post-lockdown interaction	-0.019	(-0.023, -0.016)	<0.001	-0.002	(-0.004, -0.001)	0.01	0.002	(-0.001, 0.004)	0.19
Difference between start of post-lockdown and end of pre-COVID	*-16.7*	*(-18.4, -15.0)*	*<0.001*	*2.9*	*(2.1, 3.7)*	*<0.001*	*1.1*	*(0.03, 2.1)*	*0.04*
Post-lockdown trend (change per year)	*2.2*	*(1.2, 3.2)*	*<0.001*	*-0.5*	*(-1.0, -0.04)*	*0.03*	*-2.1*	*(-2.7, -1.5)*	*<0.001*
Model 3									
Intercept	18.8	(17.0, 20.6)	<0.001	4.2	(3.4, 5.0)	<0.001	12.5	(11.4, 13.5)	<0.001
Days since 1/4/2018	0.021	(0.019, 0.023)	<0.001	0.001	(0.001, 0.002)	0.0009	-0.004	(-0.005, -0.003)	<0.001
Post-lockdown vs remaining time	-7.1	(-11.6, -2.6)	0.002	5.5	(3.6, 7.3)	<0.001	2.4	(-0.2, 4.9)	0.07
Days*post-lockdown interaction	-0.014	(-0.018, -0.011)	<0.001	-0.003	(-0.004, -0.002)	<0.001	-0.001	(-0.003, 0.001)	0.15
1st lockdown	0.5	(-1.6, 2.5)	0.66	-1.3	(-2.1, -0.4)	0.004	-1.3	(-2.4, -0.1)	0.03
2nd lockdown	-3.5	(-7.0, 0.006)	0.0504	-3.4	(-4.9, -1.9)	<0.001	3.0	(1.0, 5.1)	0.003
3rd lockdown	-18.2	(-20.6, -15.9)	<0.001	3.3	(2.3, 4.3)	<0.001	2.0	(0.7, 3.3)	0.003

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- There was a significant decrease in average daily attendances for patients referred by NHS 111 calls during post-lockdown period as compared to pre-COVID period in both NNUH (-5.3, 95% CI -6.2 to -4.5) and QEH (-3.7, 95% CI -4.2 to -3.2). However, significant increase was found in JPUH (2.7, 95% CI 2.4 to 3.1).

Model 2:

- During pre-COVID period, a significant increase per day in daily attendances was observed for patients referred by NHS 111 calls in NNUH, while notable decrease was found in QEH. Daily attendances for patients referred by NHS 111 calls in JPUH remained level off in pre-COVID period.
- A big decrease was observed in average daily attendances for patients who were referred by NHS 111 calls immediately after lockdown compared to start of study period in QEH (-4.2, 95% CI -5.2 to -3.3). A vast increase was spotted in JPUH (3.6, 95% CI 2.8 to 4.3), while a small increase was found in NNUH (1.7, 95% CI 0.2 to 3.2).
- Daily attendances increased by 2.2 units per year during post-lockdown period in NNUH (95% CI 1.2 to 3.2) for patients who were referred by NHS 111 calls but decreased by 2.1 attendances in QEH (95% CI -2.7 to -1.5). A slight decrease was found in JPUH (-0.5, 95% CI -1.0 to -0.04).

Changes in average waiting time between arrival at, and departure from, ED

*Table 10: Coefficient, 95% CI and p-value of linear regression model for **average ED waiting time in minutes between arrival and departure** in NNUH, JPUH and QEH (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	232.5	(220.6, 244.4)	<0.001	149.0	(138.8, 159.2)	<0.001	163.8	(150.3, 177.4)	<0.001
Post-lockdown vs pre-COVID	112.1	(106.7, 117.5)	<0.001	81.7	(77.0, 86.3)	<0.001	95.4	(89.1, 101.6)	<0.001
Model 2									
Intercept	215.8	(205.2, 226.5)	<0.001	157.7	(148.0, 167.4)	<0.001	176.6	(165.4, 187.7)	<0.001
Time trend	0.114	(0.098, 0.130)	<0.001	0.018	(0.003, 0.032)	0.02	0.039	(0.022, 0.056)	<0.001
Post-lockdown vs pre-COVID	40.5	(29.2, 51.9)	<0.001	26.8	(18.8, 34.8)	<0.001	3.6	(-5.6, 12.9)	0.44
Days*post-lockdown interaction	0.610	(0.548, 0.672)	<0.001	0.150	(0.131, 0.169)	<0.001	0.251	(0.229, 0.272)	<0.001
Days-squared*post-lockdown interaction	-0.001	(-0.001, -0.001)	<0.001	--	--	--	--	--	--
Difference between start of post-lockdown and end of pre-COVID	*-42.1*	*(-54.2, -30.0)*	*<0.001*	*13.8*	*(4.9, 22.7)*	*0.002*	*-24.7*	*(-34.9, -14.5)*	*<0.001*
Post-lockdown trend (change per year)	--	--	--	*61.2*	*(56.0, 66.5)*	*<0.001*	*105.7*	*(99.7, 111.7)*	*<0.001*

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- There was significant increase in mean of daily average waiting time in minutes between arrival and departure in all three hospitals during post-lockdown period as compared to pre-COVID period (NNUH: 112.1, 95% CI 106.7 to 117.5; JPUH: 81.7, 95% CI 77.0 to 86.3; QEH: 95.4, 95% CI 89.1 to 101.6). The highest increase in mean of daily average waiting time was observed in NNUH.

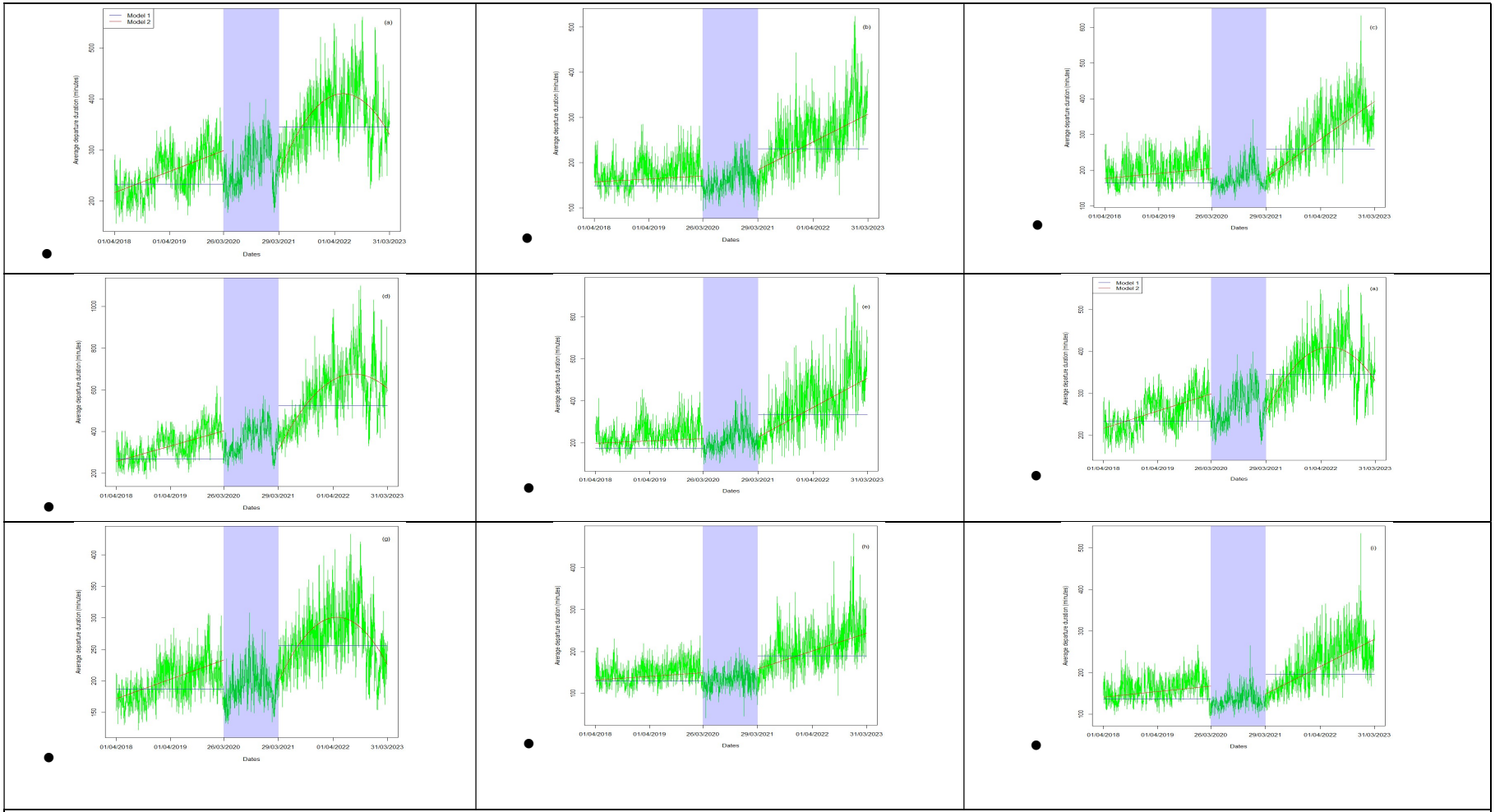
Model 2:

- Significant average increase per day was observed during pre-COVID period in daily average waiting time (minutes) in all three hospitals.
- As compared to the start of study period, significant increase was observed immediately after lockdown in daily average waiting time (minutes) between arrival and departure in both NNUH (40.5, 95% CI 29.2 to 51.9) and JPUH (26.8, 95% CI 18.8 to 34.8). However, it remained level off in QEH.

Daily average waiting time during post-lockdown period in NNUH had curvilinear trend. Hence, we applied a second-degree polynomial regression model to fit the data. Figure 2 presents the observed and predicted daily average waiting time in NNUH and showed that in 2021/22

daily average waiting time is increasing and in 2022/23 its decreasing. In both JPUH and QEH, daily average waiting time increased almost 40% and 60% per year, respectively (JPUH: 61.2, 95% CI 56.0 to 66.5; QEH: 105.7, 95% CI 99.7 to 111.7).

Figure 15 (next page) shows the scatter graphs and fitted regression lines corresponding to these analyses and results, with steep increases post-COVID at all ED departments, but decreasing over the latest year in NNUH.



(a) All ED attendances in NNUH, (b) All ED attendances in JPUH, (c) All ED attendances in QEH, (d) Ambulance arrival in NNUH, (e) Ambulance arrival in JPUH, (f) Ambulance arrival in QEH, (g) Non-ambulance arrival in NNUH, (h) Non-ambulance arrival in JPUH, (i) Non-ambulance arrival in QEH

Figure 15: Average waiting time between arrival and departure in NNUH

Waiting time for patients arriving by ambulance

*Table 11: Coefficient, 95% CI and p-value of linear regression model for **average waiting time in minutes between arrival and departure for patients' arriving by ambulance** in NNUH, JPUH and QEH (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	269.2	(244.1, 294.2)	<0.001	176.1	(154.0, 198.3)	<0.001	205.0	(175.5, 234.5)	<0.001
Post-lockdown vs pre-COVID	254.5	(243.0, 266.0)	<0.001	158.4	(148.3, 168.6)	<0.001	209.7	(196.2, 223.2)	<0.001
Model 2									
Intercept	256.6	(235.3, 278.0)	<0.001	198.7	(178.1, 219.2)	<0.001	241.1	(217.5, 264.7)	<0.001
Time trend	0.203	(0.171, 0.235)	<0.001	0.031	(-0.00008, 0.062)	0.051	0.060	(0.024, 0.095)	0.00106
Post-lockdown vs pre-COVID	56.9	(34.2, 79.6)	<0.001	30.1	(13.0, 47.1)	0.0006	-5.2	(-24.7, 14.4)	0.61
Days*post-lockdown interaction	1.219	(1.096, 1.343)	<0.001	0.351	(0.310, 0.391)	<0.001	0.587	(0.541, 0.634)	<0.001
Days-squared*post-lockdown interaction	-0.001	(-0.0016, -0.0012)	<0.001	--	--	--	--	--	--
Difference between start of post-lockdown and end of pre-COVID	*-90.2*	*(-114.5, -66.0)*	*<0.001*	*7.6*	*(-11.3, 26.5)*	*0.43*	*-48.3*	*(-70.0, -26.6)*	*<0.001*
Post-lockdown trend (change per year)	--	--	--	*139.4*	*(128.2, 150.6)*	*<0.001*	*236.0*	*(223.2, 248.9)*	*<0.001*

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- During post-lockdown period the mean of daily average waiting time between arrival and departure in minutes became approximately double as compared to pre-COVID period in all three hospitals (NNUH: 254.5, 95% CI 243.0 to 266.0; JPUH: 158.4, 95% CI 148.3 to 168.6; QEH: 209.7, 95% CI 196.2 to 223.2). The highest daily average waiting time was observed in NNUH.

Model 2:

- During pre-COVID period, there was significant increase per day in daily average waiting time between arrival and departure (minutes) of patients arrived by ambulance in both NNUH and QEH. While in JPUH daily average waiting time remained fixed during pre-COVID period.
- A big increase was observed in mean of daily average waiting time in minutes between arrival and departure of patients arrived by ambulance immediately after lockdown compared to the start of study period in both NNUH (56.9, 95% CI 34.2 to 79.6) and JPUH (30.1, 95% CI 13.0 to 47.1). However, no significant change was observed in QEH.
- Like all arrivals, daily average waiting time during post-lockdown period in NNUH had curvilinear trend and hence second-degree polynomial regression was fitted for the data (Figure 3). During post-lockdown period, daily average waiting time first increased and then decreased in

NNUH. In JPUH, daily average waiting time increased more than two third per year (139.4, 95% CI 128.2 to 150.6) in comparison with daily average waiting time at the start of study period and it became almost double in QEH (236.0, 95% CI 223.2 to 248.8).

Waiting time for patients arriving not by ambulance

*Table 22: Coefficient, 95% CI and p-value of linear regression model for average waiting time in minutes between arrival and departure for **patients arriving not by ambulance** in NNUH, JPUH and QEH (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
				Model 1					
Intercept	187.2	(178.0, 196.4)	<0.001	129.3	(120.9, 137.8)	<0.001	136.9	(127.3, 146.5)	<0.001
Post-lockdown vs pre-COVID	68.7	(64.5, 72.9)	<0.001	60.3	(56.4, 64.2)	<0.001	59.9	(55.5, 64.3)	<0.001
				Model 2					
Intercept	171.8	(163.2, 180.4)	<0.001	132.1	(123.7, 140.5)	<0.001	141.3	(132.8, 149.9)	<0.001
Time trend	0.085	(0.072, 0.098)	<0.001	0.024	(0.011, 0.037)	<0.001	0.036	(0.024, 0.049)	<0.001
Post-lockdown vs pre-COVID	27.8	(18.7, 37.0)	<0.001	26.5	(19.5, 33.5)	<0.001	7.5	(0.4, 14.6)	0.04
Days*post-lockdown interaction	0.430	(0.380, 0.480)	<0.001	0.092	(0.076, 0.109)	<0.001	0.143	(0.126, 0.160)	<0.001
Days-squared*post-lockdown interaction	-0.0007	(-0.0007, -0.0006)	<0.001	--	--	--	--	--	--
Difference between start of post-lockdown and end of pre-COVID	*-33.6*	*(-43.4, -23.4)*	*<0.001*	*9.2*	*(1.4, 16.9)*	*0.02*	*-18.9*	*(-26.8, -11.1)*	*<0.001*
Post-lockdown trend (change per year)	--	--	--	*42.4*	*(37.8, 47.0)*	*<0.001*	*65.5*	*(60.9, 70.1)*	*<0.001*

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- The mean of daily average waiting time in minutes between arrival and departure increased significantly during post-lockdown period compared to pre-COVID period for patients arriving not by ambulance in all three hospitals (NNUH: 68.7, 95% CI 64.5 to 72.9; JPUH: 60.3, 95% CI 56.4 to 64.2; QEH: 59.9, 95% CI 55.5 to 64.3). The daily average waiting time was highest in NNUH.

Model 2:

- Significant increase per day was observed in daily average waiting time (in minutes) between arrival and departure during pre-COVID period for patients arriving not by ambulance in all three hospitals.
- A significant increase in daily average waiting time in minutes was observed immediately after lockdown compared to the start of study period in all three hospitals (NNUH: 27.8, 95% CI 18.7 to 37.0; JPUH: 26.5, 95% CI 19.5, 33.5; QEH: 7.5, 95% CI 0.4 to 14.6).
- Similar to all arrivals and arrivals by ambulance, a second-degree polynomial regression was applied to fit the daily average waiting time in minutes for patients not arriving by ambulance in NNUH as the daily average waiting time during post-lockdown period had curvilinear trend. Daily average waiting time first increased and then decreased in post-lockdown period. There was a significant increase in daily average waiting time per year during post-lockdown period in both JPUH and QEH (JPUH: 42.4, 95% CI 37.8 to 47.0; QEH: 65.5, 95% CI 60.9 to 70.1).

Changes in daily number of minor injury unit attendances

✓ There were 87,581 attendances in the minor injury units during the period 2018/19 to 2022/23. Among them 74,439 attendances were in NNUH and 13,142 were in JPUH.

Table 33: Coefficient, 95% CI and p-value of linear regression model for total daily number of attendances in the minor injury units (adjusted for day of week and month of year)

Models and variables	Model 1			Model 2			Model 3		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Intercept	89.0	(84.2, 93.7)	<0.001	122.6	(119.4, 125.8)	<0.001	114.9	(112.0, 117.8)	<0.001
Time trend	--	--	--	-0.120	(-0.125, -0.115)	<0.001	--	--	--
Days since 1/4/2018	--	--	--	--	--	--	-0.096	(-0.099, -0.093)	<0.001
Post-lockdown vs pre-COVID	-44.3	(-46.5, -42.1)	<0.001	-87.5	(-90.2, -84.8)	<0.001	-83.1	(-90.2, -76.0)	<0.001
Days*post-lockdown interaction	--	--	--	0.119	(0.112, 0.125)	<0.001	0.098	(0.092, 0.103)	<0.001
1st lockdown	--	--	--	--	--	--	-22.6	(-25.8, -19.4)	<0.001
2nd lockdown	--	--	--	--	--	--	11.0	(5.4, 16.5)	<0.001
3rd lockdown	--	--	--	--	--	--	-10.6	(-14.9, -6.3)	<0.001
Difference between start of post-lockdown and end of pre-COVID	--	--	--	*-0.5*	*(-3.5, 2.5)*	*0.73*	--	--	--
Post-lockdown trend (change per year)	--	--	--	*-0.4*	*(-2.2, 1.3)*	*0.62*	--	--	--

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- There was a significant decrease (almost half of the pre-COVID period) in average daily attendances during post-lockdown period in the minor injury units (-44.3, 95 % CI -46.5 to -42.1).

Model 2:

- Daily attendances to minor injury units during pre-COVID period decreased significantly per day (-0.120, 95% CI -0.125 to -0.115).
- There was a decrease of approximately 88 average daily attendances at the start of post-lockdown period compared to start of study period (-87.6, 95% CI -90.2 to -84.8).
- During post-lockdown period, yearly attendances remained level.

Individual level predictors of daily number of ED attendances made by each resident of N&W in one year: patient level dataset 2022-23

- There were 1043047 observations in the dataset. The subset based on 611 LSOAs in N&W, the dataset becomes a size of 1027475 observations. Among the observations, 50.3% (n=516682) were female, 49.7% were male (n=510740) and the remaining 53 observation did not specify their gender (not known and not specified) and removed from the analysis. So, the reduced dataset has 1027422 observations.

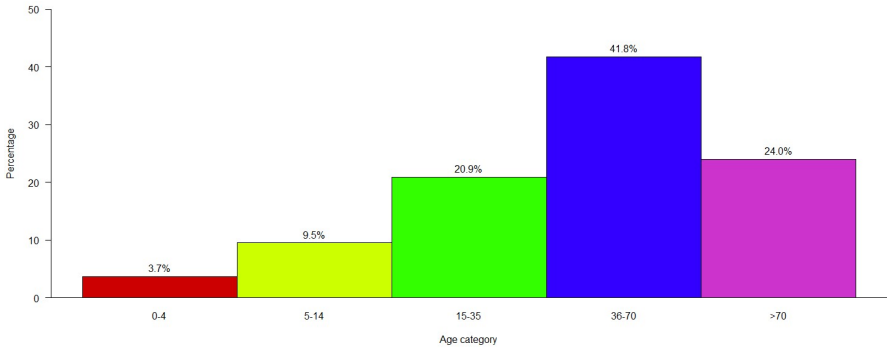


Figure 16: Age distribution of observations

- The average age is 48.52 years, and its median is 50 years. Figure 16 presents the age distribution of the observations. Only 3.7% observations were under 5 years of old and 24.0% were aged greater than 70 years. More than two fifth (41.8%) of the observations were from age group 36 to 70 years.

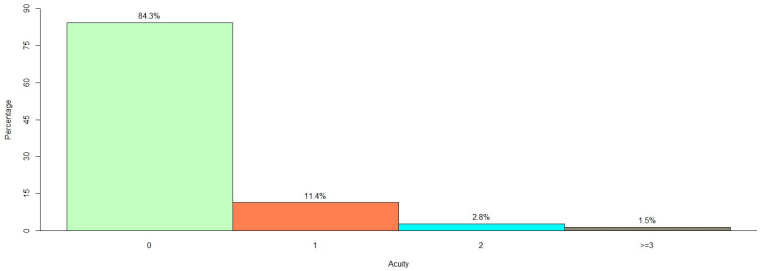


Figure 172: Acuity distribution

- The data shows that 84.3% of observations did not visit hospital in the last 12 months and only 1.5% visited 3 or more times (Figure 17).

- Among the observations, around three fifth were white (59.9%, n=615562), 37.9% (n=389011) were missing or do not know their ethnicity and the remaining were from another ethnicity.

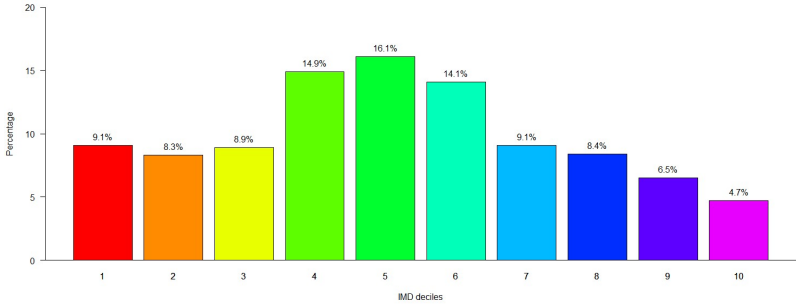


Figure 18: Distribution of index of multiple deprivation in N&W

The mean and median of IMD in N&W was 5.13 and 5.00, respectively. An approximately equal proportions of observations belong to first, second and third deciles (9.1%, 8.3% and 8.9%, respectively). The highest proportions of observations were from the fifth decile. After sixth decile, the percentage of observations declined quickly. Only around 5% of observations belong to highest decile of IMD.

Table 44: Predictors of number of ED attendances in 2022/23 year by each individual person in Norfolk and Waveney: Poisson regression models

_	Model 1			Model 2			Model 3			Model 4		
Variables	IRR	95% CI	p-value	IRR	95% CI	p-value	IRR	95% CI	p-value	IRR	95% CI	p-value
Age <=4	1.2543	(1.2330, 1.2760)	<0.001	2.1305	(2.0206, 2.2463)	<0.001	2.0849	(1.9766, 2.1991)	<0.001	1.9264	(1.8240, 2.0346)	<0.001
Age 5-14	0.9154	(0.9017, 0.9294)	<0.001	1.0146	(0.9858, 1.0442)	0.324	1.0560	(1.0256, 1.0873)	<0.001	1.1514	(1.1159, 1.1881)	<0.001
Age 15-35 (ref)	--	--	--	--	--	--	--	--	--	--	--	--
Age 36-70	0.7176	(0.7099, 0.7255)	<0.001	0.5325	(0.5250, 0.5402)	<0.001	0.5988	(0.5902, 0.6076)	<0.001	0.5938	(0.5847, 0.6029)	<0.001
Age >70	0.9248	(0.9141, 0.9357)	<0.001	0.4743	(0.4666, 0.4821)	<0.001	0.6186	(0.6079, 0.6295)	<0.001	0.6840	(0.6718, 0.6965)	<0.001
Female (ref)	--	--	--	--	--	--	--	--	--	--	--	--
Male	1.0157	(1.0076, 1.0240)	<0.001	0.9502	(0.9407, 0.9598)	<0.001	0.9607	(0.9510, 0.9706)	<0.001	1.0322	(1.0212, 1.0433)	
White (ref)	--	--	--	--	--	--	--	--	--	--	--	--
Not known/missing	0.1132	(0.1113, 0.1151)	<0.001	0.1569	(0.1537, 0.1601)	<0.001	0.1517	(0.1486, 0.1549)	<0.001	0.2547	(0.2493, 0.2602)	<0.001
Other	0.9814	(0.9601, 1.0032)	0.094	1.0267	(0.9912, 1.0635)	0.142	1.0423	(1.0062, 1.0797)	0.021	1.0869	(1.0477, 1.1275)	<0.001
IMD (numeric)	0.9502	(0.9486, 0.9518)	<0.001	0.9538	(0.9519, 0.9558)	<0.001	0.9539	(0.9519, 0.9559)	<0.001	0.9562	(0.9542, 0.9583)	<0.001
Distance (10km)	0.8569	(0.8463, 0.8676)	<0.001	0.8522	(0.8392, 0.8653)	<0.001	0.8490	(0.8360, 0.8621)	<0.001	0.8194	(0.8064, 0.8327)	<0.001
Distance square (100km^2)	1.0276	(1.0249, 1.0302)	<0.001	1.0275	(1.0241, 1.0308)	<0.001	1.0286	(1.0253, 1.0320)	<0.001	1.0328	(1.0294, 1.0363)	<0.001
Number of long term conditions (DTC)				1.1556	(1.1531, 1.1581)	<0.001	--	--	--	--	--	--
Respiratory							1.2444	(1.2310, 1.2579)	<0.001	1.1797	(1.1665, 1.1931)	<0.001
Pre-diabetes							1.0840	(1.0682, 1.1000)	<0.001	0.9157	(0.9020, 0.9295)	<0.001
Diabetes							1.1904	(1.1735, 1.2076)	<0.001	1.0644	(1.0489, 1.0802)	<0.001
Heart disease							1.3724	(1.3523, 1.3928)	<0.001	1.4402	(1.4187, 1.4621)	<0.001
Atrial fibrillation							1.4757	(1.4507, 1.5012)	<0.001	1.4113	(1.3867, 1.4363)	<0.001
Kidney disease							1.1236	(1.1047, 1.1429)	<0.001	1.1547	(1.1349, 1.1748)	<0.001
Depression							1.3766	(1.3617, 1.3916)	<0.001	1.2736	(1.2592, 1.2881)	<0.001
Hypertension							1.0586	(1.0455, 1.0719)	<0.001	1.0048	(0.9921, 1.0177)	0.457
Stroke							1.3751	(1.3423, 1.4087)	<0.001	1.4111	(1.3767,1.4463)	<0.001
Number of primary care appointments										1.0267	(1.0265, 1.0270)	<0.001

Table 15: Modification to Model 1 above: Each IMD decile compared to most deprived IMD decile

	Model 1(a)		
Variables	IRR	95% CI	p-value
Age <=4	1.2540	(1.2327, 1.2757)	<0.001
Age 5-14	0.9153	(0.9015, 0.9292)	<0.001
Age 15-35 (ref)	--	--	--
Age 36-70	0.7180	(0.7102, 0.7259)	<0.001
Age >70	0.9260	(0.9153, 0.9369)	<0.001
Female (ref)	--	--	--
Male	1.0157	(1.0075, 1.0239)	<0.001
White (ref)	--	--	--
Not known/missing	0.1132	(0.1113, 0.1151)	<0.001
Other	0.9804	(0.9591, 1.0022)	0.078
IMD1 (ref) most deprived)	--	--	--
IMD2	0.8904	(0.8749, 0.9062)	<0.001
IMD3	0.8851	(0.8699, 0.9007)	<0.001
IMD4	0.8012	(0.7881, 0.8145)	<0.001
IMD5	0.7736	(0.7610, 0.7865)	<0.001
IMD6	0.7532	(0.7407, 0.7659)	<0.001
IMD7	0.6993	(0.6862, 0.7126)	<0.001
IMD8	0.6841	(0.6712, 0.6974)	<0.001
IMD9	0.6504	(0.6370, 0.6641)	<0.001
IMD10 (least deprived)	0.6118	(0.5974, 0.6266)	<0.001
Distance (per 10km)	0.8661	(0.8550, 0.8773)	<0.001
Distance square (per 100km^2)	1.0261	(1.0234, 1.0288)	<0.001

- ✓ Model 1: Considers all 1,027,422 individuals.
- ✓ Model 2: Removed 437858 individuals due to missingness in number of long-term conditions.
- ✓ Model 3: Removed 437858 individuals due to missingness in long-term conditions.
- ✓ Model 4: Removed 584522 individuals due to missingness in long-term conditions and number of primary care appointments.

- **Model 1 (IMD as continuous):**

➢ All the selected covariates had significant association with the average number of yearly hospital attendances.

- There were 25% (IRR 1.25, 95% CI 1.23 to 1.28) more average number of hospital attendances who were less than 5 years old than those who were 15 to 35 years old. Individuals who were between 5 to 14 years and greater than 70 years old both had approximately 8% (IRR 0.92) and those who were between 36 to 70 years old had 28% (IRR 0.72, 95% CI 0.71 to 0.73) less average number of hospital attendances.
- Male had 2% (IRR 1.02, 95% CI 1.01 to 1.02) more average number of hospital attendances than female.
- Individuals whose ethnicity were not known/missing had extremely lower (89%) average number of hospital attendances (IRR 0.11, 95% CI 0.11 to 0.12) than white ethnic group.
- For a unit increase in IMD decile, there was 5% (IRR 0.95, 95% CI 0.95 to 0.95) decrease in the average number of hospital attendances.
- For every 10km increase in distance to the nearest hospital, the rate of ED attendances decreased (IRR 0.86). However, the effect of distance on ED attendances decreased with decreasing distance (as shown by IRR=1.03 for distance squared).

Model 1(a) (interpreting IMD as factor):

- ED attendances decreased steadily with increasing IMD decile (i.e., decreasing deprivation). With individuals in the least deprived decile (IMD10) had 39% less average number of ED attendances as individuals in the most deprived decile (IMD1) (IRR = 0.61).

Model 2: (including number of long term conditions)

- There was 16% (IRR 1.16, 95% CI 1.15 to 1.16) increase in the average number of hospital attendances for an additional long-term condition.
- The mean number of hospital attendances decreased significantly with the increase of age.
- With the inclusion of number of long-term conditions, the effect of sex on the average number of hospital attendances gives opposite direction as compared to Model 1. Male had 5% (IRR 0.95, 95% 0.94 to 0.95) less average number of hospital attendances compared to female.
- Individuals with unknown/missing ethnicity had 84% (IRR 0.16, 95% CI 0.15 to 0.16) less average number of hospital attendances as compared to white ethnic group.

Model 3: (including specific long term conditions)

- The association between the average number of hospital attendances and sociodemographic conditions remained same as Model 2 except that there was a 2% increase in the average number of hospital attendances for the individuals greater than 70 years compared to individuals who were 36 to 70 years old (Age >70: IRR 0.62, 95% CI 0.61 to 0.63 vs Age 35-70: IRR 0.60, 95% CI 0.59 to 0.61).
- The average number of hospital attendances increased significantly with the diagnosis of each long-term condition.

Model 4: (including specific long term conditions and number of primary care appointments)

- For every increase of one primary care appointments per year, the average number of hospital attendances increased by 3% (IRR 1.03, 95% CI 1.03 to 1.03).

NHS 111 telephone calls

- There were 1,461,880 NHS 111 calls during the period 2018/19 to 2022/23. Among the calls, 56.0% (n=818520) were from female, 43.7% (n=639427) were from male and the remaining 3933 calls did not specify their gender (not known).
- Before COVID period daily number of calls were approximately evenly distributed. During lockdown period daily calls increased slightly and post-lockdown it's decreasing (Figure 19).

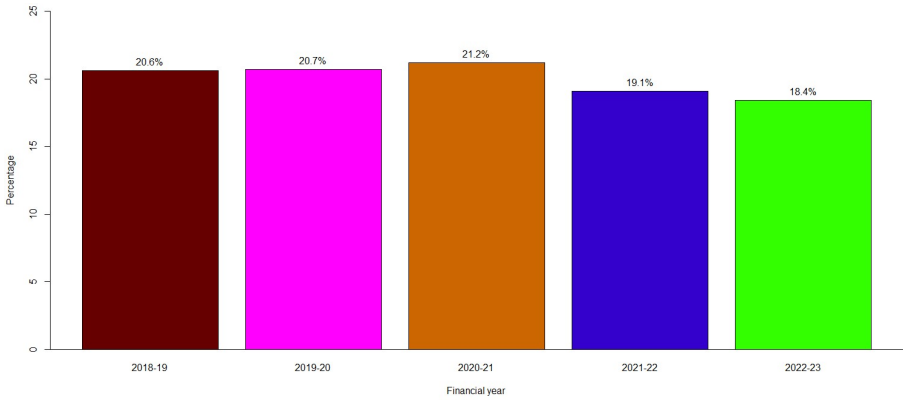


Figure 19: Distribution of NHS 111 calls based on financial year.

- More than half (54.4%) of the calls were recommended to attend primary and community care service (PCCS), followed by ambulance dispatch (14.5%) and not recommended to attend other service (OS) (13.8%). The remaining 17.1% patients were equally recommended to attend either ED or OS (8.5% vs 8.6%). A small proportion (0.3%, n=3973) of calls placement information is missing.
- The calls were approximately uniformly distributed among the financial quarters. However, more than two-fifth of calls were made on Saturday and Sunday (42.2%) and remaining calls were quite evenly distributed among five weekdays with highest percentage of calls occurred on Monday (12.9%).
- Around three quarter (73.7%) of calls occurred out of hours. (Calls received outside the core office hours 08.00 to 18.30 and any time on weekends and bank holidays were considered as out of hours calls.)
- More than half (54.5%) of calls required clinical assessment service and approximately three fifth (59.9%) of calls were made by the patients.
- Almost all calls were triaged (98.4%) and only 6.4% calls required call-back.

Changes in number and outcomes of NHS 111 calls

*Table16: Coefficient, 95% CI and p-value of linear regression model for **all NHS 111 calls** and five disposition groups separately in N&W (adjusted for day of week and month of year)*

Models and variables	Number of daily calls			Ambulance dispatches			Not recommend attending OS		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	713.5	(681.8, 745.1)	<0.001	108.3	(103.2, 113.5)	<0.001	99.4	(94.5, 104.2)	<0.001
Post-lockdown vs pre-COVID	-72.9	(-87.4, -58.3)	<0.001	-26.5	(-28.9, -24.1)	<0.001	-12.2	(-14.4, -10.0)	<0.001
Model 2									
Intercept	684.6	(650.0, 719.2)	<0.001	108.5	(102.9, 114.0)	<0.001	98.5	(93.2, 103.8)	<0.001
Time trend	0.063	(0.011, 0.115)	0.02	-0.011	(-0.019, -0.003)	0.01	-0.001	(-0.009, 0.007)	0.83
Post-lockdown vs pre-COVID	-0.5	(-29.2, 28.3)	0.98	-17.1	(-21.7, -12.5)	<0.001	-7.4	(-11.8, -3.0)	0.00098
Days*post-lockdown interaction	-0.198	(-0.267, -0.130)	<0.001	-0.026	(-0.037, -0.015)	<0.001	-0.013	(-0.023, -0.003)	0.02
Difference between start of post-lockdown and end of pre-COVID	-46.3	(-78.2, -14.5)	0.004	-9.1	(-14.2, -4.0)	0.0005	-6.8	(-11.6, -1.9)	0.007
Post-lockdown trend (change per year)	-49.3	(-68.1, -30.5)	<0.001	-13.4	(-16.4, -10.4)	<0.001	-5.1	(-8.0, -2.2)	0.0006

Models and variables	Recommended to attend ED			Recommended to attend OS			Recommended to attend PCCS		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	70.8	(67.4, 74.2)	<0.001	55.1	(48.9, 61.3)	<0.001	378.1	(357.8, 398.4)	<0.001
Post-lockdown vs pre-COVID	-26.3	(-27.8, -24.8)	<0.001	2.7	(-0.2, 5.6)	0.06	-8.9	(-18.3, 0.4)	0.06
Model 2									
Intercept	66.2	(62.6, 69.9)	<0.001	32.2	(26.2, 38.3)	<0.001	376.0	(353.5, 398.4)	<0.001
Time trend	0.017	(0.012, 0.023)	<0.001	0.063	(0.053, 0.072)	<0.001	0.001	(-0.033, 0.035)	0.95
Post-lockdown vs pre-COVID	-21.4	(-24.4, -18.3)	<0.001	49.1	(44.1, 54.1)	<0.001	-0.2	(-18.9, 18.4)	0.98
Days*post-lockdown interaction	-0.014	(-0.021, -0.006)	<0.001	-0.127	(-0.139, -0.115)	<0.001	-0.024	(-0.068, 0.020)	0.29
Difference between start of post-lockdown and end of pre-COVID	-33.9	(-37.3, -30.5)	<0.001	3.8	(-1.7, 9.3)	0.18	-1.0	(-21.6, 19.7)	0.93
Post-lockdown trend (change per year)	1.3	(-0.7, 3.3)	0.19	-23.6	(-26.9, -20.4)	<0.001	-8.3	(-20.6, 3.9)	0.18

Time trend: Days since 1/4/2018 and since 30/03/2021. OS other service. PCCS primary care service.

Model 1:

- There were around 714 calls per day during pre-COVID period and this figure was reduced by approximately 73 (95% CI -87.4 to 58.3) calls per day in post-lockdown period. In post-lockdown period, number of calls reduced significantly for all disposal groups except those who were recommended to attend OS and PCCS (Ambulance dispatch: -26.5, 95% CI -28.9 to -24.1; Not recommended to attend OS: -12.2, 95% CI -14.4 to -10.0; Recommended to attend ED: -26.3, 95% CI -27.8 to -24.8). The highest percentage of decrease was observed for patients who were recommended to attend ED (37%).

Model 2:

- Significant average increase per day in all daily calls was observed in pre-COVID period. Patients dispatched by ambulance was decreased significantly per day and recommended to attend either ED or OS were increased significantly during pre-COVID period.
- Overall, no significant difference was observed in mean daily calls between the start of post-lockdown period and the start of study period. However, significant reduction was observed for patients dispatched by ambulance (-17.1, 95% CI -21.7 to -12.5), recommended to attend ED (-21.4, 95% CI -24.4 to -18.3) and not recommended to attend OS (-7.4, 95% CI -11.8 to -3.0) and a huge decrease (152%) was observed for patients recommended to attend OS (49.1, 95% CI 44.1 to 54.1). No significant change was discovered for patients recommended to attend PCCS.
- During post-lockdown period, calls per year decreased significantly overall (-49.3, 95% CI -68.1 to -30.5), patients dispatched by ambulance (-13.4, 95% CI -16.5 to -10.4), not recommended to attend OS (-5.1, 95% CI -8.0 to -2.2) and recommended to attend OC (-23.6, 95% CI 26.9 to -20.4). However, during post-lockdown period calls remained level of for patients recommended to ED and recommended to attend PCCS.

Ambulance callouts

- Analysed only those ambulance data which went to the three hospitals (NNUH, JPUH and QEH) from 2018/19 to 2022/23.
- The number of ambulances went to NNUH, JPUH and QEH were 244359, 117542 and 88812, respectively, during the period 2018/19 to 2022/23.
- The calls received through 999 were 78.9% (n=355770) while through 111 were 21.1% (94943).
- There is a downward trend on the number of ambulance callouts over the last five years (Figure 20).

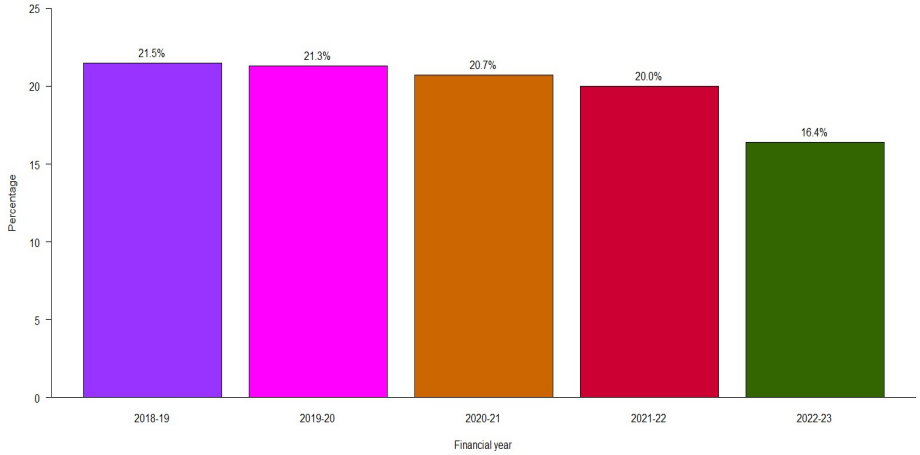


Figure 20: Yearly ambulance callouts distribution

Changes in daily number of ambulance callouts

*Table 17: Coefficient, 95% CI and p-value of linear regression model for **all ambulance calls** and calls through **111 & 999** in N&W (adjusted for day of week and month of year)*

Models and variables	All ambulance calls			Ambulance calls through NHS 111			Ambulance calls through 999		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	276.7	(270.9, 282.6)	<0.001	56.3	(53.6, 59.0)	<0.001	220.4	(215.7, 225.1)	<0.001
Post-lockdown vs pre-COVID	-39.4	(-42.1, -36.7)	<0.001	-19.8	(-21.1, -18.6)	<0.001	-19.6	(-21.7, -17.4)	<0.001
Model 2									
Intercept	267.9	(263.1, 272.7)	<0.001	53.9	(51.1, 56.7)	<0.001	214.0	(210.0, 218.0)	<0.001
Time trend	-0.004	(-0.012, 0.003)	0.23	0.00047	(-0.004, 0.005)	0.83	-0.005	(-0.011, 0.001)	0.11
Post-lockdown vs pre-COVID	4.1	(0.1, 8.1)	0.04	-9.3	(-11.6, -6.9)	<0.001	13.4	(10.0, 16.7)	<0.001
Days*post-lockdown interaction	-0.119	(-0.128, -0.110)	<0.001	-0.029	(-0.034, -0.023)	<0.001	-0.090	(-0.098, -0.082)	<0.001
Difference between start of post-lockdown and end of pre-COVID	*7.3*	*(2.9, 11.7)*	*0.0011*	*-9.6*	*(-12.2, -7.0)*	*<0.001*	*16.9*	*(13.2, 20.6)*	*<0.001*
Post-lockdown trend (change per year)	*-45.0*	*(-47.6, -42.4)*	*<0.001*	*-10.4*	*(-11.9, -8.9)*	*<0.001*	*-34.6*	*(-36.8, -32.5)*	*<0.001*

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- There was significant decrease in average daily ambulance calls during post-lockdown period (-39.4, 95% CI -42.1 to -36.7) and subgroups of calls through 111 (-19.8, 95% CI -21.1 to -18.6) and through 999 (-19.6, 95% CI -21.7 to -17.4). Ambulance calls through 111 decreased by one third, the highest percentage of decrease.

Model 2:

- During pre-COVID period, daily all ambulance calls and calls through 111 and 999 did not change significantly (per day).
- A small increase was found in average daily ambulance calls immediately after lockdown compared to the start of study period (4.1, 95% CI 0.1 to 8.1) and a notable increase was observed for calls through 999 (13.4, 95% CI 10.0 to 16.7). While a significant decrease was observed for calls through 111 (-9.3, 95% CI -11.6 to -6.9).
- During post-lockdown period, all ambulance calls reduced significantly by 45.0 calls per year (95% CI -47.6 to -42.4) and calls through111 and 999 dropped per year by 10.4 and 34.6 calls, respectively (NHS 111 calls: 95% -11.9 to -8.9; 999 calls: 95% CI -36.8 to -32.5).

Changes in the percentage of ambulance callouts ending with delayed handovers to ED of at least 30, and more than 60, minutes

*Table 18: Coefficient, 95% CI and p-value of linear regression model for percentage of **ambulance calls that have handover duration of at least 30 minutes** in N&W (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	12.3	(9.2, 15.5)	<0.001	-0.5	(-4.0, 3.0)	0.79	21.1	(17.4, 24.9)	<0.001
Post-lockdown vs pre-COVID	11.2	(9.7, 12.6)	<0.001	28.6	(27.0, 30.2)	<0.001	7.3	(5.5, 9.0)	<0.001
Model 2									
Intercept	16.6	(13.7, 19.5)	<0.001	0.9	(-2.0, 3.8)	0.53	26.3	(22.6, 30.0)	<0.001
Time trend	0.001	(-0.003, 0.006)	0.62	0.017	(0.012, 0.021)	<0.001	-0.003	(-0.009, 0.002)	0.27
Post-lockdown vs pre-COVID	-8.9	(-11.3, -6.5)	<0.001	7.5	(5.2, 9.9)	<0.001	-13.1	(-16.2, -10.0)	<0.001
Days*post-lockdown interaction	0.055	(0.049, 0.061)	<0.001	0.058	(0.052, 0.063)	<0.001	0.056	(0.048, 0.063)	<0.001
Difference between start of post-lockdown and end of pre-COVID	*-9.7*	*(-12.4, -7.0)*	*<0.001*	*-4.6*	*(-7.2, -1.9)*	*0.0007*	*-10.8*	*(-14.2, -7.4)*	*<0.001*
Post-lockdown trend (change per year)	*20.4*	*(18.8, 22.0)*	*<0.001*	*27.1*	*(25.5, 28.7)*	*<0.001*	*19.2*	*(17.2, 21.2)*	*<0.001*

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- There was significant increase in average percentage of daily ambulance calls that have handover duration of at least 30 minutes in all three hospitals during post-lockdown period (NNUH: 11.2, 95% CI 9.7 to 12.6; JPUH: 28.6, 95% CI 27.0 to 30.2; QEH: 7.3, 95% CI 5.5 to 9.0). The biggest increase was observed in JPUH.

Model 2:

- There was significant increase per day in average percentage of daily ambulance calls that have handover duration of at least 30 minutes was observed in JPUH during pre-COVID period. In other two hospitals, percentage of daily ambulance calls that have handover duration of at least 30 minutes remained level off.
- As compared to the start of study period, significant decrease was observed in percentage of daily ambulance calls that have handover duration of at least 30 minutes immediately after lockdown in both NNUH (-8.9, 95% -11.3 to -6.5) and QEH (-13.1, 95% CI -16.2 to -10.0). While a significant increase was observed in JPUH (7.5, 95% CI 5.2 to 9.9).

- Percentage of daily ambulance calls that have handover duration of at least 30 minutes increased approximately 20% per year post-lockdown in NNUH (20.4, 95% CI 18.8 to 22.0) and QEH (19.2, 95% CI 17.2 to 21.2). The highest percentage of yearly increase was in JPUH (27.1, 95% CI 25.5 to 28.7).

*Table 19: Coefficient, 95% CI and p-value of linear regression model for percentage of **ambulance calls that have handover duration more than 60 minutes** in N&W (adjusted for day of week and month of year)*

Models and variables	NNUH			JPUH			QEH		
	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Model 1									
Intercept	-2.2	(-4.9, 0.5)	0.11	-5.2	(-8.2, -2.3)	0.00054	4.1	(0.7, 7.4)	0.017
Post-lockdown vs pre-COVID	15.5	(14.3, 16.8)	<0.001	21.2	(19.8, 22.6)	<0.001	13.6	(12.1, 15.1)	<0.001
Model 2									
Intercept	3.4	(1.1, 5.7)	0.003	-3.0	(-5.5, -0.4)	0.022	5.7	(2.5, 9.0)	0.00056
Time trend	-0.004	(-0.007, -0.001)	0.022	0.009	(0.005, 0.013)	<0.001	0.009	(0.004, 0.014)	<0.001
Post-lockdown vs pre-COVID	-6.2	(-8.1, -4.3)	<0.001	2.6	(0.5, 4.7)	0.015	-1.8	(-4.5, 0.9)	0.19
Days*post-lockdown interaction	0.059	(0.055, 0.064)	<0.001	0.051	(0.046, 0.056)	<0.001	0.042	(0.036, 0.048)	<0.001
Difference between start of post-lockdown and end of pre-COVID	*-3.2*	*(-5.3, -1.1)*	*0.003*	*-4.1*	*(-6.5, -1.8)*	*0.0005*	*-8.3*	*(-11.3, -5.3)*	*<0.001*
Post-lockdown trend (change per year)	*20.2*	*(18.9, 21.4)*	*<0.001*	*21.9*	*(20.6, 23.3)*	*<0.001*	*18.6*	*(16.8, 20.4)*	*<0.001*

Time trend: Days since 1/4/2018 and since 30/03/2021

Model 1:

- Like percentage of ambulance calls that have handover duration of at least 30 minutes, the average of daily percentage of handover duration more than 60 minutes had highest increase in JPUH (21.2, 95% CI 19.8 to 22.6) in the post-lockdown period. There was also significant increase in both NNUH (15.5, 95% CI 14.3 to 16.8) and QEH (13.6, 95% CI 12.1 to 15.1).

Model 2:

- Significant increase per day was observed in daily percentage of handover duration more than 60 minutes in NNUH during pre-COVID period and significant decrease was found in JPUH and QEH.
- A big decrease was observed in average of daily percentage of ambulance calls that have handover duration more than 60 minutes in NNUH immediately after lockdown compared to the start of study period (-6.2, 95% CI -8.1 to -4.3) and a small increase was detected in JPUH (2.6, 95% CI 0.5 to 4.7). No significant change was noticed in QEH.
- In all three hospitals, the average daily percentage of handover duration more than 60 minutes rose around 20% per year post-lockdown (NNUH: 20.2, 95% CI 18.9 to 21.4; JPUH: 21.9, 95% CI 20.6 to 23.3; QEH: 18.6, 95% CI 16.8 to 20.4).