FEBRUARY 28, 2020

AMBULATORY CARE EXPERIENCE (ACE) FOR CHILDREN IN BRADFORD- CARING FOR UNWELL CHILDREN IN THE COMFORT OF THEIR HOME

EVALUATION REPORT

Data sharing agreement

Reference (University of Sheffield, Connected Health Cities): RQ0003

UNIVERSITY OF YORK

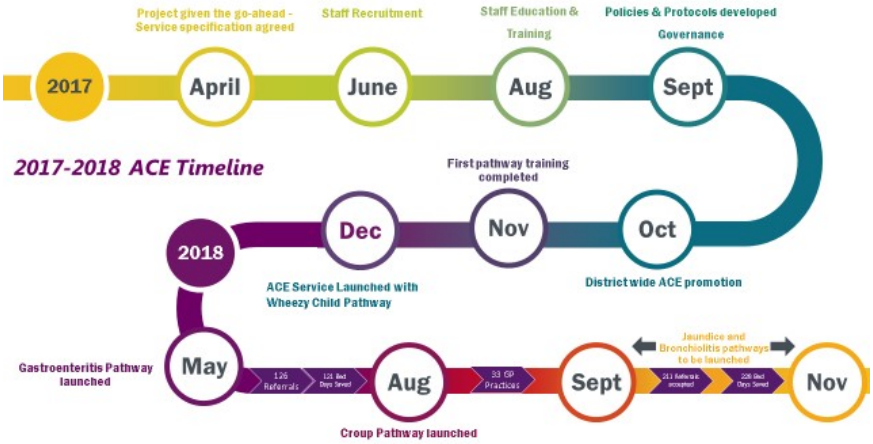
Contents

BACKGROUND

Children and young people (CYP) are more frequent users of Accident & Emergency (A&E) than adults,[1] especially where access to primary care is poor.[2] There are currently 5.5 million A&E attendances by CYP in England, making up 26% of all age A&E attendances. Overall CYP attendances to A&E is projected to increase by 50% to 2030 if current trends are maintained.[3] In 2015/2016, 39% of all hospital admissions in children were classified as emergency admissions.[4] There was an absolute increase of 14% in emergency admissions in this age group and a 30% increase in those under 5 years between 2005/2006 and 2015/2016. This increase was in acute (26% increase) rather than chronic conditions (9% decrease).[5]

Acute bronchitis, upper respiratory tract and intestinal infections, asthma and jaundice (in neonates) are among the 10 most common conditions diagnosed on emergency admission in CYP.[6] These are all considered ambulatory care sensitive conditions for which admissions can be prevented by interventions in Primary Care.[7] Majority of these are considered to be unnecessary and most could have been cared for in their homes.[8] There are already indications that improvements in some areas like telephonic consultation with the GPs, 'virtual wards' and tele monitoring might lead to reduction in secondary care services.

In Bradford, the ACE (Ambulatory Care Experience) is a standardised service intervention that aims to reduce hospital referrals from primary care to secondary care and allow redirection of CYP attending Secondary Care to more appropriate care back in the community. The service is a collaboration between GPs, the local CCG and Bradford Teaching Hospitals NHS Foundation Trust (BTHFT). It comprises various clinical care pathways for CYP (targeting different age groups) namely; Wheezy Child, Gastroenteritis, Croup to reduce emergency service use i.e. A&E visits and emergency admissions, and Bronchiolitis and Jaundice Pathways to reduce length of stay in hospital. These pathways were planned to launch sequentially during a 12 month period as below.



The Wheezy Child Pathway was launched in December 2017. So far, three pathways namely, Wheezy Child, Gastroenteritis and Croup have been launched as planned, and Jaundice and Bronchiolitis Pathways are currently being piloted (in February 2020). These pathways provide

alternative community-based urgent care and are delivered by a nurse in child's own home and on-call consultant paediatrician based in the hospital who takes full clinical responsibility for patients in a 'virtual ward'. Cases can be referred to the service from Primary Care, as well as the A&E and Children's Clinical Decision Area at Bradford Royal Infirmary (BRI).

Despite national recommendations to increase ambulatory care provision, there is very little research into evaluating the impact of such initiatives. A U.S. study suggested that home visits by community health workers to support adherence to recommended care may be cost effective in reducing health care utilisation by children with ambulatory care sensitive conditions (ACSCs).[9] A recently published Cochrane systematic review of school-based interventions on self-management of asthma (a ACSC) has reported reduction in the number of acute episodes of healthcare usage.[10] This review included studies mostly from the U.S. and none from the UK. Moreover, primary evaluations of the community based interventions to reduce health care use in children with ACSCs in the UK are currently completely absent. Hence, we aimed to conduct a quantitative evaluation of the three ACE pathways on emergency service use (emergency admissions and A&E visits) by CYP.

OBJECTIVES

Specific objectives were to;

1. Assess data usability for the proposed quasi-experimental evaluation of ACE pathways and explore potential comparators
2. Assess trends/change in trends over time in overall emergency admissions and A&E visits and by sub-groups of diagnoses (ICD-10 diagnoses sub-groups)
3. Quantify the number of emergency admissions and A&E visits for children (0-16 years) with conditions targeted by the ACE intervention, before and after intervention implementation in BTHFT
4. Assess the impact of the three ACE pathways on emergency admissions and A&E visits using quasi-experimental approach

METHODS

Setting

Yorkshire & Humber

Time period

From 01st January 2012 to 31st May 2019.

Data sources

Admitted Patient Care (APC) and Accident & Emergency (A&E).

Data acquisition

Data were received from two sources;

1) Raw extract of both APC and A&E data for Bradford from the Secondary Uses Service (SUS) was provided by Bradford Institute for Health Research (BIHR) data management team

2) APC and A&E data for Yorkshire & Humber (including for Bradford) from University of Sheffield (UoS), Connected Health Cities (CHC).

Case identification

We used A&E diagnostic codes [11] and ICD-10 codes to identify condition-specific diagnoses. Codes to identify each ACE-targeted condition are presented in Appendix-1. Visits due to asthma/wheeze were identified using diagnosis codes in primary and all secondary diagnosis fields OR nebulisation treatment codes in primary and secondary treatment fields (after excluding croup diagnosis). Visits due to gastroenteritis, croup, bronchiolitis and jaundice were identified using ICD-10 and A&E diagnosis codes (where applicable) in primary and all secondary diagnosis fields.

ANALYSES

We assessed completeness of data and performed quality checks for missing diagnosis, duplicate entries, coding errors, treatment codes, seasonal patterns and outliers. We also assessed if the data contained any identifiable information. Hospital Episodes Statistics (HES) Data Dictionaries for APC and A&E[12] were used to identify variables and categories of interest.

Outcome

Using both primary and all secondary diagnosis fields, we calculated;

a) The number and percentage of A&E visits and emergency admissions and trends over time in potential comparator groups for Wheezy Child Pathway (using data sets from UoS)
b) The number and percentage of emergency admissions in children 16 years and under with ACE-targeted conditions
c) Trends over time in the percentage of admissions due to wheeze/asthma and gastroenteritis in children targeted by respective pathways

Descriptive analysis

Using data sets from UoS;

1) We assessed parallel trends assumption by graphically comparing pre-ACE trends of emergency admissions and A&E visits in children (2-16 year olds) targeted by Wheezy Child Pathway with following potential comparator groups;
    a) Children under 2 years with asthma/wheeze diagnosis or nebulisation treatment codes without croup diagnosis, in Bradford
    b) Children 2-16 years with asthma/wheeze diagnosis or nebulisation treatment code without croup diagnosis, in the rest of Yorkshire & Humber

Using data from BTHFT in 0-16 year olds;

2) We assessed quarterly trends (pre- and post-ACE) in the number of all emergency admissions and A&E visits
3) We grouped emergency admissions into 22 main WHO ICD-10 diagnoses sub-groups using 'Primary diagnosis variable' available at[13] and graphically assessed variation over years

4) Before we could embark on actual evaluation, we performed further exploratory analysis of trends (both pre- and post-ACE) over time in emergency admissions by;
    a. Sex
    b. Method of admission (identifies how the patient was admitted to hospital. It is recorded on the first and all subsequent episodes within the spell)
    c. Specialty code- into 'Paediatrics', 'ENT', and 'others' (field that defines the specialty under which the consultant is contracted)
    d. Frequency of episodes within a Hospital provider spell (a spell can have one or more than one episodes)
    e. Duration of spell (in days)
5) We assessed monthly and weekly trends of admissions due to asthma (2-16 year olds) and gastroenteritis (1-6 year olds) in respective age groups targeted by these pathways

Statistical analysis

We intended to use quasi-experimental design to evaluate the impact of ACE pathways depending on;

- Identifying a suitable comparator
- Number of time points/series (pre- and post-intervention)
- Variability within the data/strength of the effect size/autocorrelation (seasonality)

A general recommendation to conduct time-series analysis is for 12 data points before and 12 data points after the intervention. This number is not based on estimates of power, rather with 24 monthly measures, the analysts can adequately evaluate seasonal variation. There also needs to be a sufficient number of observations (a minimum of 100 is) at each data point of the time-series to achieve an acceptable level of variability of the estimate at each time point.[14]

Scenario 1:

If we have a suitable comparator but the data is not compatible with interrupted time-series analysis (ITSA) standards[15], we will apply a difference-in-difference (DiD) analysis, to assess the difference in change between intervention and comparator in the outcomes of interest over time, given it meets the common trend assumption (i.e. in the absence of intervention, unobserved differences between intervention and control groups would be the same over time).[16]

Scenario 2:

With no comparator, but data compatible with ITSA standards, we will apply ITSA without comparison time series. The outcome of interest will be regressed on a constant term, a time trend variable for the entire study period, a dummy variable indicating the post-intervention period, and an interaction term between the time trend and the intervention dummy. The estimated coefficient of intervention dummy will measure the immediate level change after the implementation of the new care pathway while the coefficient of the interaction term will be the estimated change of time trend for the post-intervention period. We will allow 2-3 months for period of implementation to allow gradual roll-out of intervention where implementation will be modelled as gradual slope/change.

In standard ITSA, the following segmented regression model will be used:

$$Y_t = \beta_0 + \beta_1 T + \beta_2 X_t + \beta_3 T X_t$$

T: the time elapsed since the start of the study in with the unit representing the frequency with which observations are taken (e.g. month or year)

X_t: a dummy variable indicating the pre-intervention period (coded 0) or the post-intervention period (coded 1);

Y_t: the outcome at time t

Where b_0 represents the baseline level at T=0, b_1 is interpreted as the change in outcome associated with a time unit increase (representing the underlying pre-intervention trend), b_2 is the level change following the intervention and b_3 indicates the slope change following the intervention (using the interaction between time and intervention TX_t)

Secondly, using segmented Poisson regression analysis, we will model the quarterly rates of A&E attendance and emergency admissions in the intervention group per total A&E attendance and emergency admissions to hospital.

Scenario 3 (best-case scenario):

If there is a suitable comparator and the data is compatible with ITSA standards, we will conduct ITSA with comparison time series. In this case, we will extend the standard ITS model by adding interaction terms between a dummy indicating the comparator condition and the four components of the standard model mentioned above.

We list all intervention and potential comparator groups for ACE pathways below;

Pathway	Intervention	Potential comparator/s
Wheezy Child	children 2-16 years old in Bradford Teaching Hospital Trust (BTHFT)	1) Children <two years with AWC in Bradford OR 2) Children 2-16 with AWC in the rest of Yorkshire & Humber
Gastroenteritis	1 year to under 6 years in BTHFT	children 1 year to <6 with gastroenteritis in the rest of the Yorkshire and Humber
Croupy child	1 year to under 6 years in BTHFT	children 1 year to <6 with croup in the rest of the Yorkshire and Humber

RESULTS

Data from UoS included APC and A&E data sets for Yorkshire & Humber spanning January 2012-March 2017. These pre-ACE data provided an opportunity for the assessment of comparator groups for intervention pathways.

Data from BIHR constituted APC and A&E data extract for Bradford between January 2012 and May 2019.

Data quality and completeness (UoS data sets)

A and E data

More than 50% (994548) of visits had no codes in any diagnosis field. Trusts like Mid-Yorkshire, Leeds Teaching Hospital and Doncaster and Bassetlaw have high percentage of visits with missing diagnosis codes. Bradford Teaching Hospital Foundation Trust (BTHFT) had very few missing diagnoses in this dataset.

Table 1: Visits by Trusts with no codes in all diagnosis fields (N=994548)

Trust	visit	% of all visits
RAE- Bradford Teaching Hospital Trust	5142	0.5
RCB- York Teaching Hospital Trust	72392	7.3
RCD- Harrogate	42676	4.3
RCF-Airdale	16959	1.7
RCU- Sheffield children's Hospital	83647	8.4
RFF- Barnsley	43397	4.4
RFR- Rotherham	74032	7.4
RHQ- Sheffield teaching	8034	0.8
RJL- Lincolnshire and Coole	7447	0.7
RP5- Doncaster and Bassetlaw	148442	14.9
RR8- Leeds teaching hospital	164045	16.5
RWA- Hull and East Yorkshire	46174	4.6
RWY- Calderdale and Huddersfield	95822	9.6
RXF- Mid-Yorkshire	186339	18.7

About 2% (31282) of visits had codes missing under both diagnosis and treatment fields.

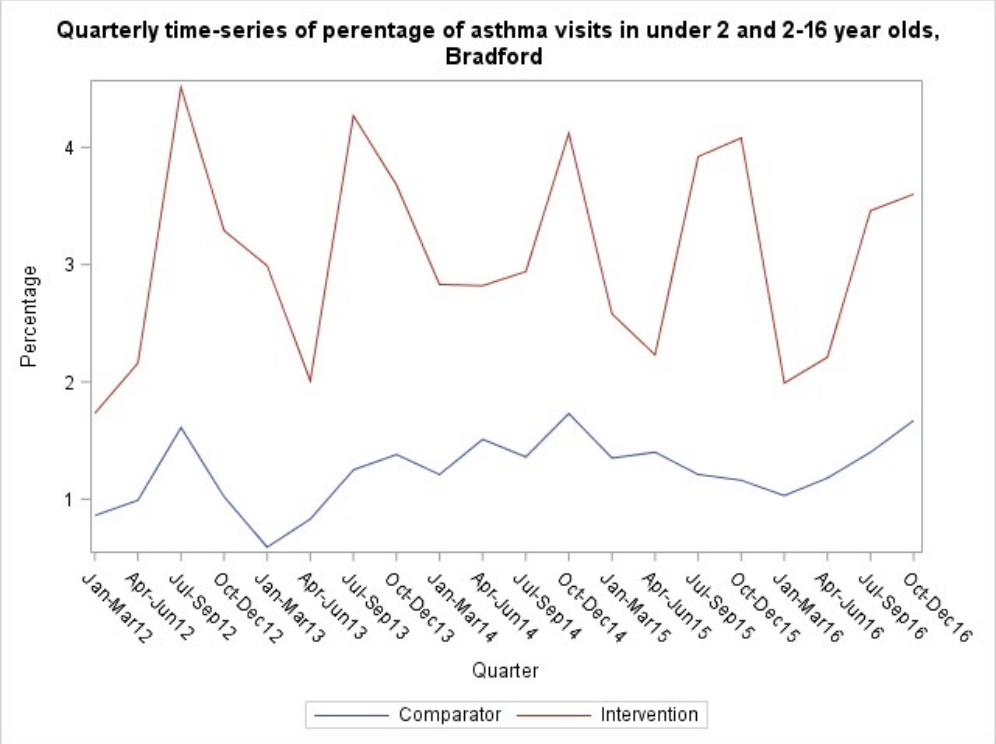
APC data

All admissions had diagnosis codes in one or more than one diagnosis fields. Of all Trusts in Y& H, Bradford Teaching Hospital Trust (coded as 'RAE') contributes to just under 9% (36562/431155) of all admissions and 21% (5218/24598) of all admissions in 2-16 year olds (Wheezy Child Pathway target group).

Potential comparator/s (A&E data)

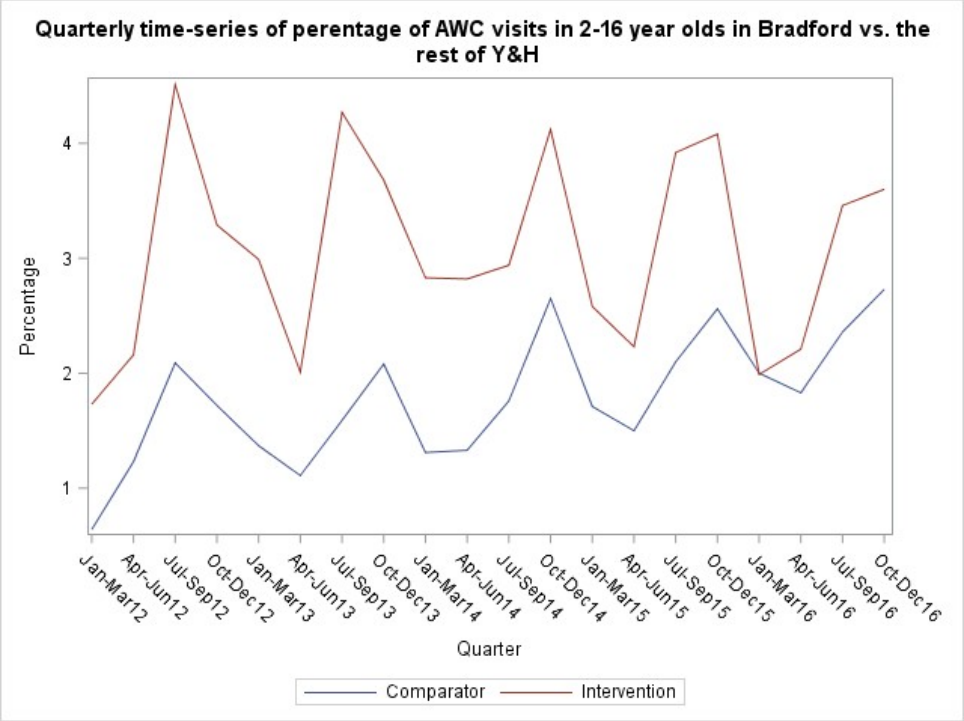
Below (pre-intervention) trends present assessment of suitable comparator/s for Wheezy Child Pathway using A&E data from UoS.

Comparator 1: The trends of the proportion of AWC visits in under 2 and 2-16 years at each quarter, in BTHFT do not appear to be approximately parallel. Therefore, the parallel trends assumption required for Difference-in-Difference or Interrupted time-series analysis does not hold.



Comparator 2: AWC in 2-16 years in the rest of Yorkshire & Humber

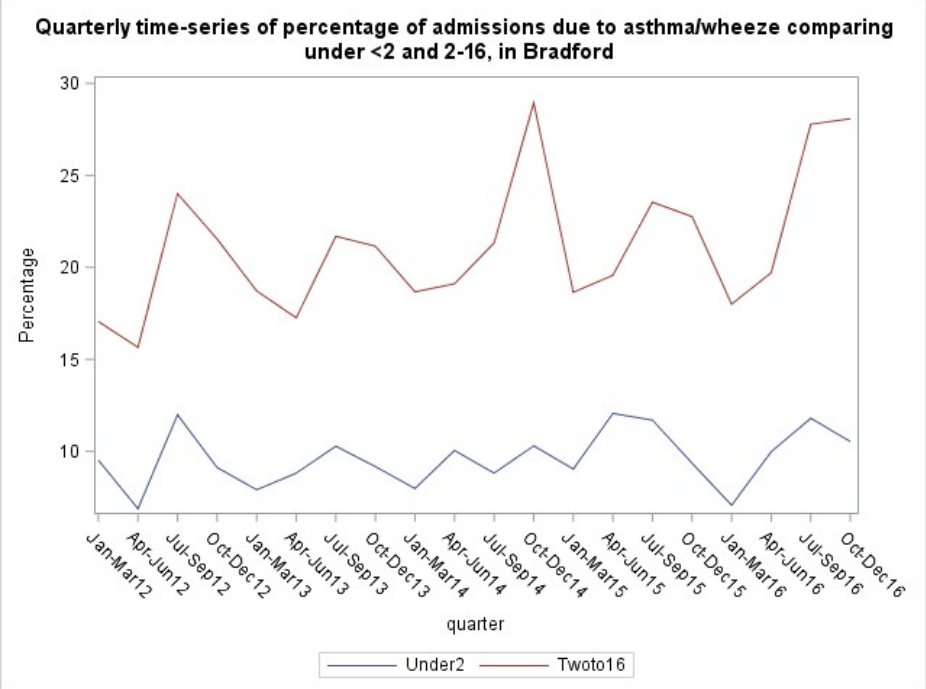
Quarterly trends below suggest a seasonal pattern in AWC presentation to A&E, with peaks between July-December (as expected), followed by sudden drop in following months, more so in 2-16 year olds. The trends in the two groups run parallel at most time-points suggesting that children (2-16 years) with AWC in the rest of Y&H can be a suitable comparator group for Wheezy Child Pathway evaluation.



Potential comparator/s APC data

Below (pre-intervention) trends present assessment of suitable comparator/s for Wheezy Child Pathway using APC data from UoS.

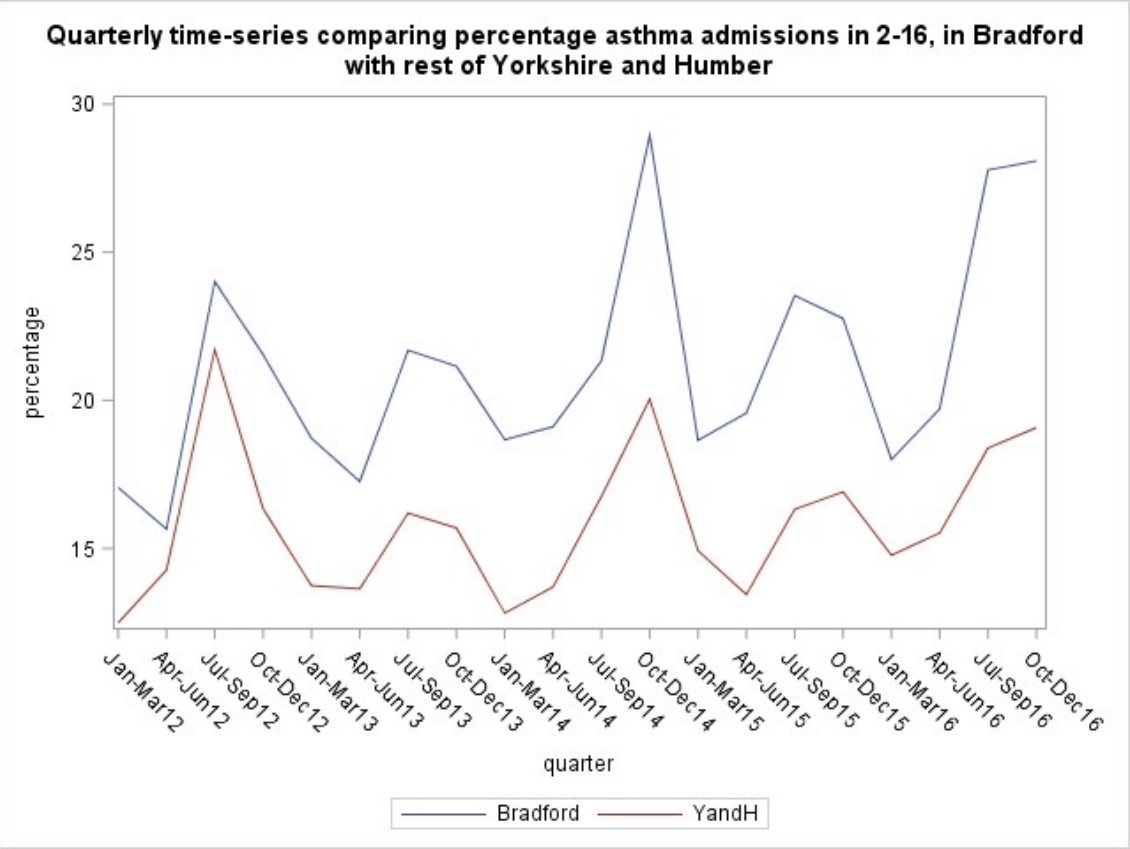
Comparator 1: Below, we display trends of quarterly admissions due to asthma in 2-16 vs. under 2 year olds, in BTHFT. It almost shows a uniform seasonal pattern in 2-16 year olds with numbers rising between April and September. It fails to meet parallel trends assumption at most time points.



Comparator 2: Asthma admissions in 2-16 years in BTHFT compared to asthma admissions in 2-16 years in the rest of Yorkshire and Humber (n=39238)

There has been steady rise in the percentage of admissions due to asthma in BTHFT since 2012, overall contributing to approximately one fifth of all admissions.

Quarterly trends comparing admissions in BTHFT and the rest of the Yorkshire & Humber show an overall higher percentage of admissions in BTHFT than in Y&H. Trends in the two groups run parallel at most time points suggesting this might be a suitable comparator group for AWC pathway evaluation using ITSA with a comparator design. However, as these data were available for pre-intervention period only, we are not able to use ITSA with a comparator for the evaluation at this point.



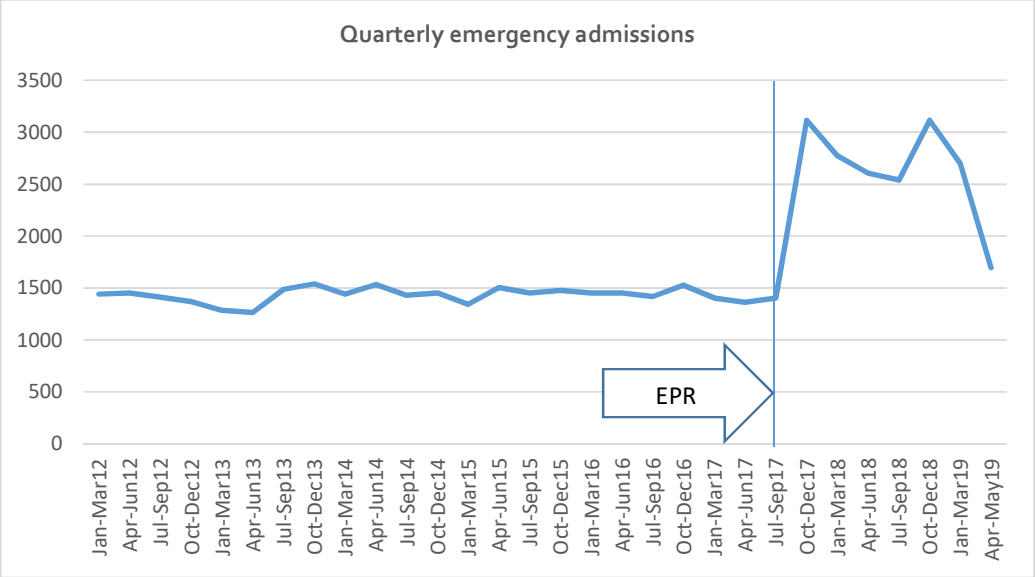
Exploratory analysis

Bradford Institute for Health Research data set (Jan 2012 to May 2019)

Admitted Patient Care

We received data on 51461 emergency admissions for 16 year and under, for 32 quarterly time-series. Data for the last quarter included admissions for Apr and May, 2019 only. Of all admissions, 54% (27977) were males. Based on case identification codes in both primary and all secondary diagnosis, approximately, 20% (10515) were due to asthma/wheeze, 6% (3166) gastroenteritis, 8% (4151) bronchiolitis, 1% (563) croup and 0.03% (18) jaundice, respectively.

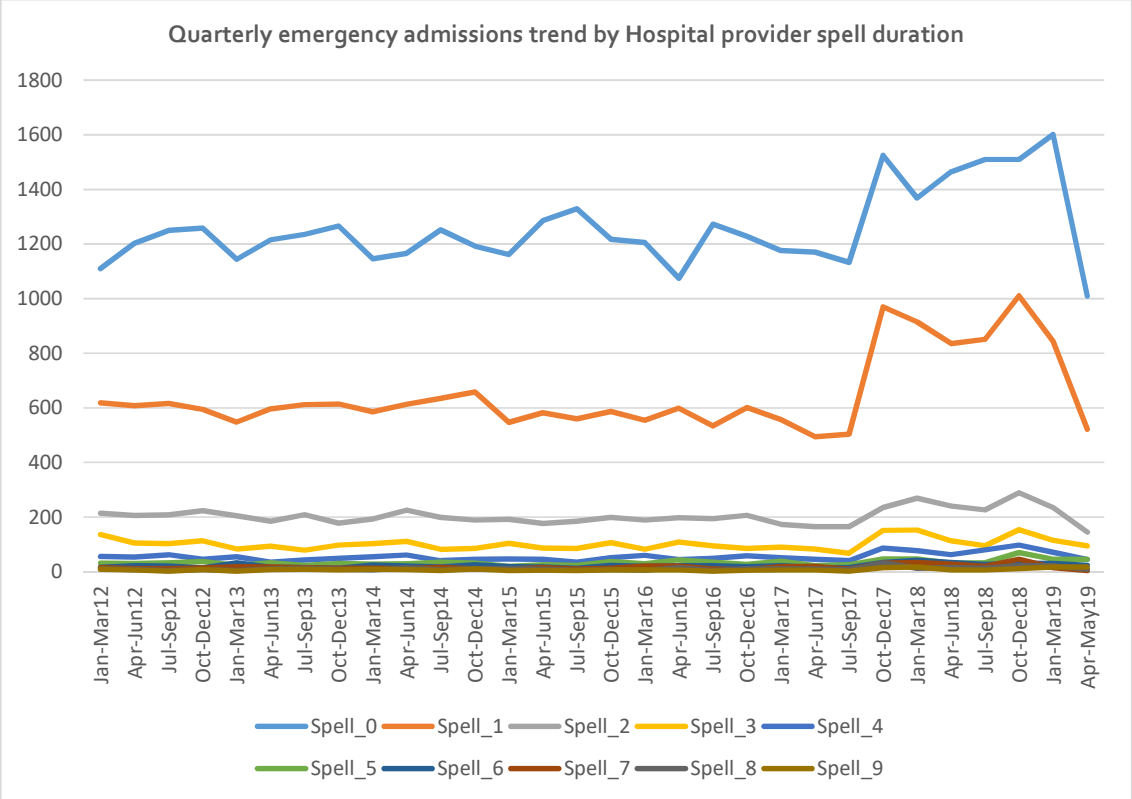
Emergency admissions show a steady trend over time with expected seasonal variation until Jul-Sep 2017, when admissions approximately doubled, from 1500 per quarter in Jan-Mar, 2012 to more than 3000 in Oct-Dec, 2017.



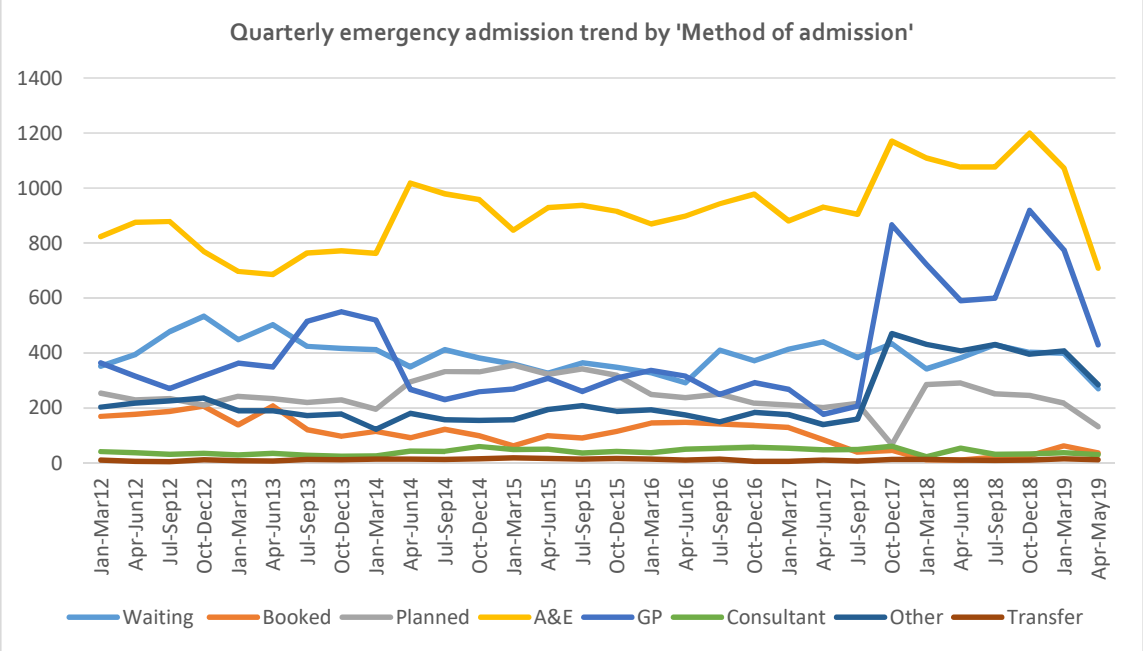
Approximately, 5% of all admission spells comprised of more than one episode.

Number of episode/s within a spell	Numbers	Percentage
1	73,866	95.13
2	3,546	4.57
3	177	0.23
4	34	0.04
5	11	0.01
6	6	0.01
7	4	0.01
8	3	0.00
9	2	0.00
10	1	0.00

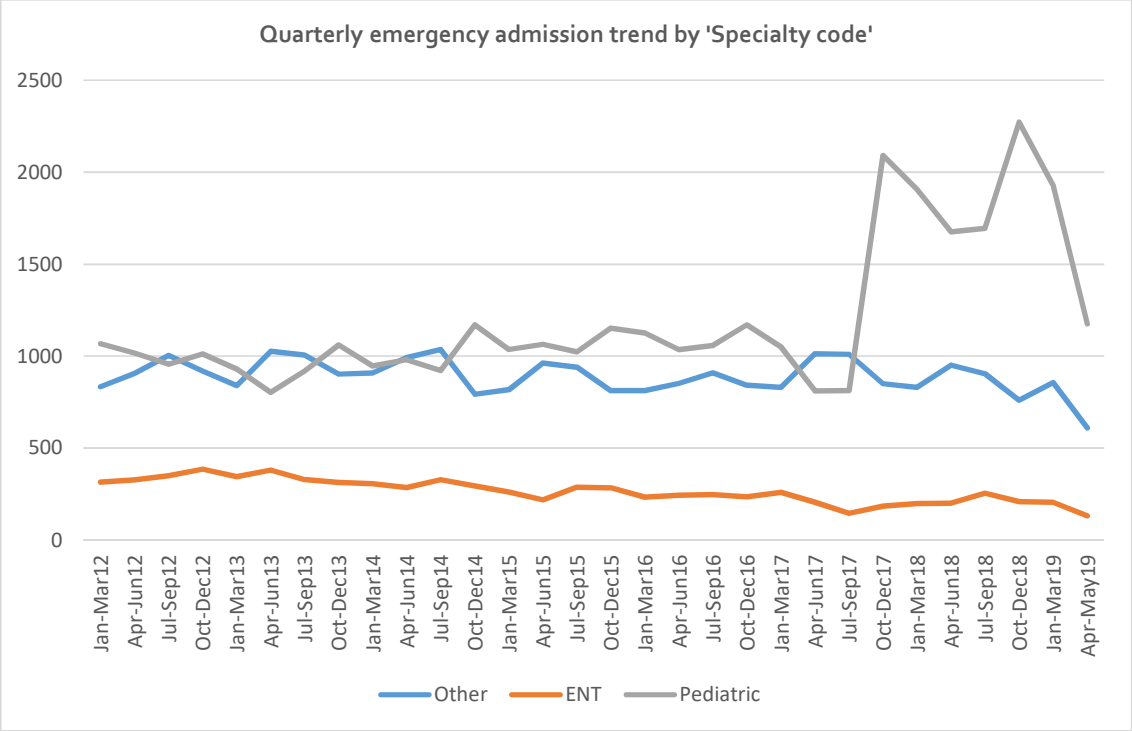
Majority of spells spanned over one day or under. Quarterly trend of admissions by duration of spell (in days) shows a similar pattern as overall admissions, peaking in Oct-Dec 2017 and subsequently decreasing in the last couple of quarters (Jan-May, 2019).



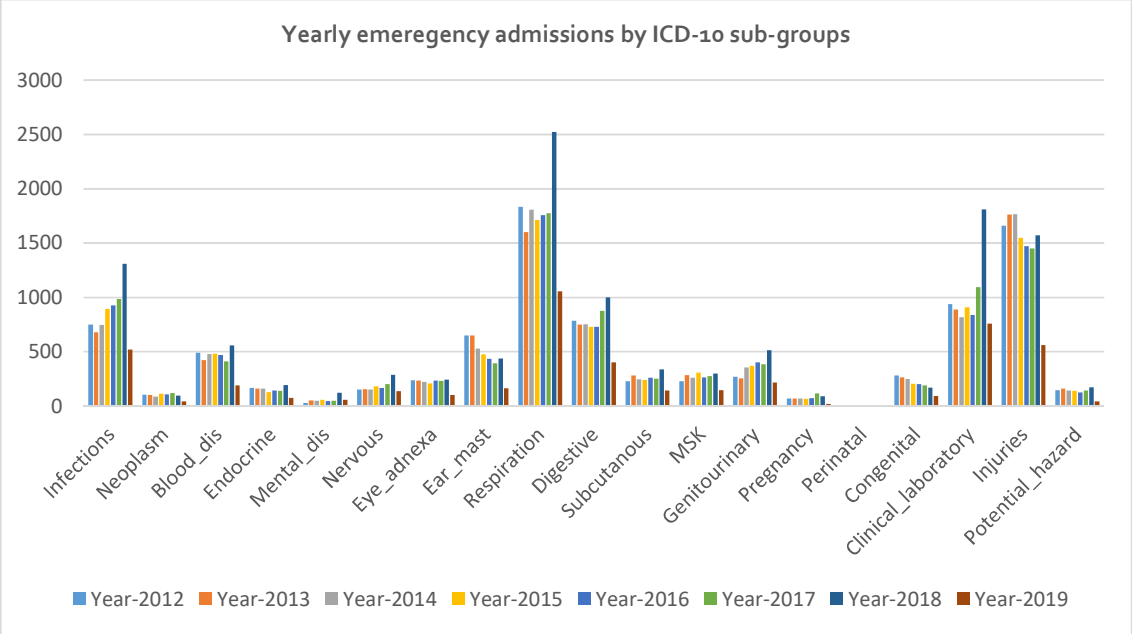
The most common method of admission was from A&E throughout the study period, subsequently followed by patients admitted electively from 'Waiting list' and referred by a 'General Practitioner'. Referral from GP increased substantially in Oct-Dec, 2017 (almost more than three times the previous quarters) with another peak observed in Oct-Dec, 2018 trending downward in the remaining two quarters.



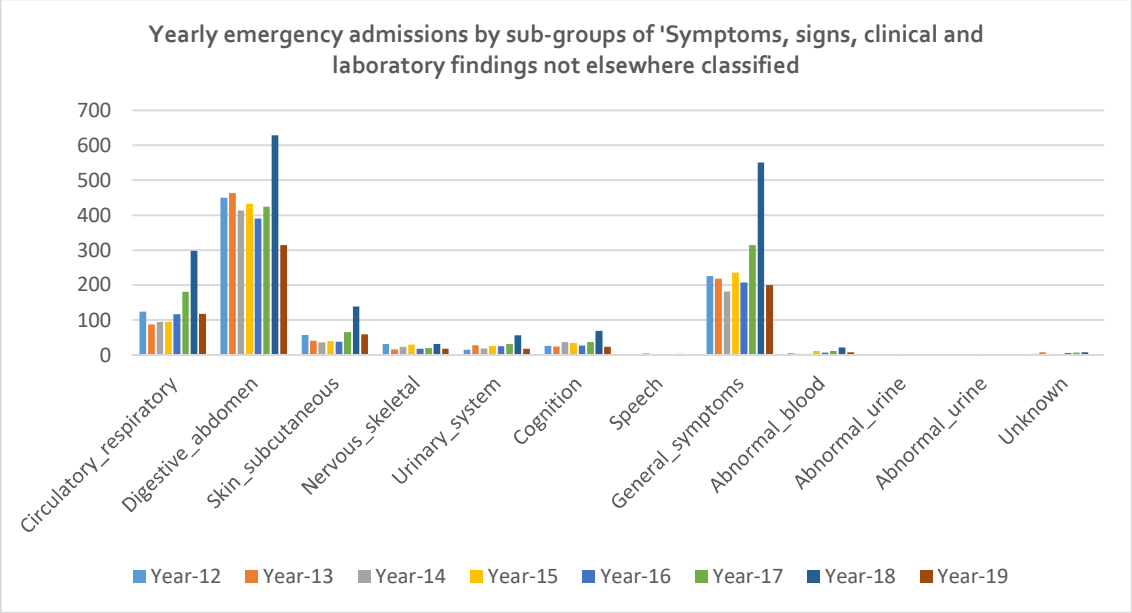
Quarterly trends by 'Specialty code' for 'ENT' and 'Other' remain stable throughout the study period. However admissions under 'Paediatrics' category, in Oct-Dec 2017, rose more than double the baseline value.



We also looked at yearly data on admissions by ICD-10 sub-groups using 'Primary diagnosis code' variable. We did not have admissions under three of the sub-groups, namely 1) Diseases of the circulatory system, 2)External causes of morbidity and mortality and 3) Codes for special puroses. Remaining 19 out of 22 sub-group categories are graphically presented below. Throughout the study period, admissions with primary diagnoses of 'Diseases of respiratory system' comprise a substantial proportion of all admissions, followed by 'Injuries, poisoning and certain other consequences of external causes', 'Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified' and 'Certain infectious and parasitic diseases'. Although, we observed a marked rise in admissions in almost all sub-groups, during 2018, 'Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified' category was markedly large in that year.



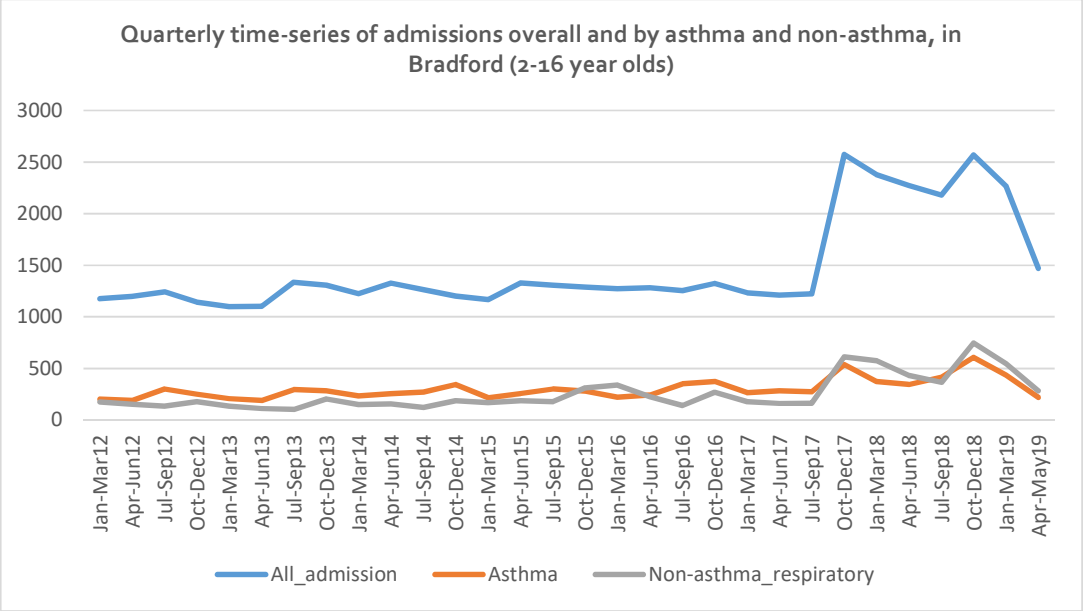
We further investigated whether certain conditions under 'Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified' dominated the others over study period. Graph below suggests that admissions with 'Symptoms and signs involving the digestive system and abdomen', 'General symptoms and signs' and 'Symptoms and signs involving the circulatory and respiratory systems' remianed predominantly higher than other categories, throughout study period.



Impact evaluation

Admitted Patient Care

Of five ACE pathways, three were launched as planned between December 2017 and August 2018. Based on exploratory graphs above, we observed a sudden rise in admissions overall and by most sub-groups in Oct-Dec, 2017 and in subsequent quarters when Wheezy Child Pathway was implemented (in December 2017). This was three months after the electronic patient record (EPR) was introduced (in September 2017). We compared admissions due to wheeze/asthma vs. other non-asthma respiratory conditions in 2-16 year old children (Wheezy Child Pathway target group). Although admissions due to asthma/wheeze increased slightly post-EPR, the rise in all admissions and in non-asthma respiratory admissions was substantial.



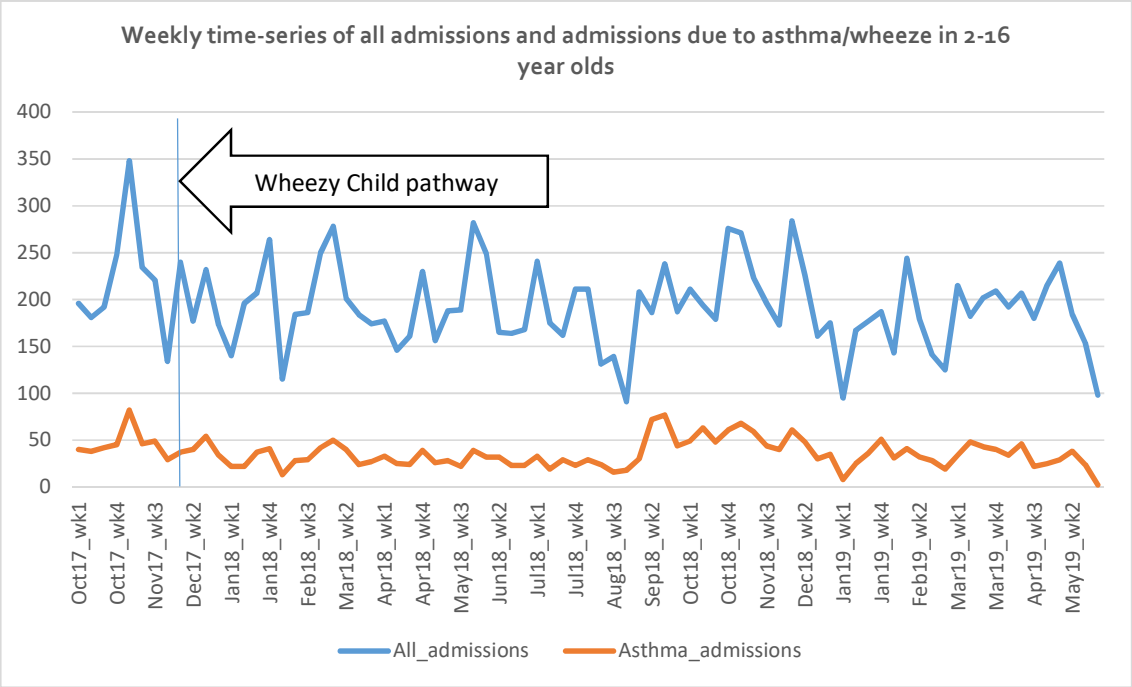
Introduction of electronic patient record (EPR)

The EPR is a centralised data base comprising a series of software applications to bring clinical and administrative data together. It's intended to provide comprehensive electronic health records for each patient including information on their medical history, health care preferences and lifestyle. In England, the NHS is managing EPR planning. It's been implemented in phases in secondary and tertiary health care system. There are a number of potential benefits from implementing EPR, for e.g. it allows clinicians to access patient's clinical records along a care pathway when and where they need it. Hence facilitating data sharing between care providers for e.g. GP surgeries, hospitals and walk-in centres. It is hoped to increase the accuracy of data with an aim to improve clinical decision making. However, it comes with some caveats around staff training on EPR, system installation and technical glitches etc.

Bradford Royal Infirmary (BRI) introduced EPR in September 2017 in all departments with clinicians being able to access patient records at the point of care across all applicable locations. We observed a sudden rise in emergency admissions in the quarter/s following EPR. We assume that the sudden rise in admissions is not the result of a significant surge in actual numbers, but rather because of; 1) the way admissions/visits are recorded and reported post-EPR, or 2) changes in classification of existing services, or 3) data extraction-related issue.

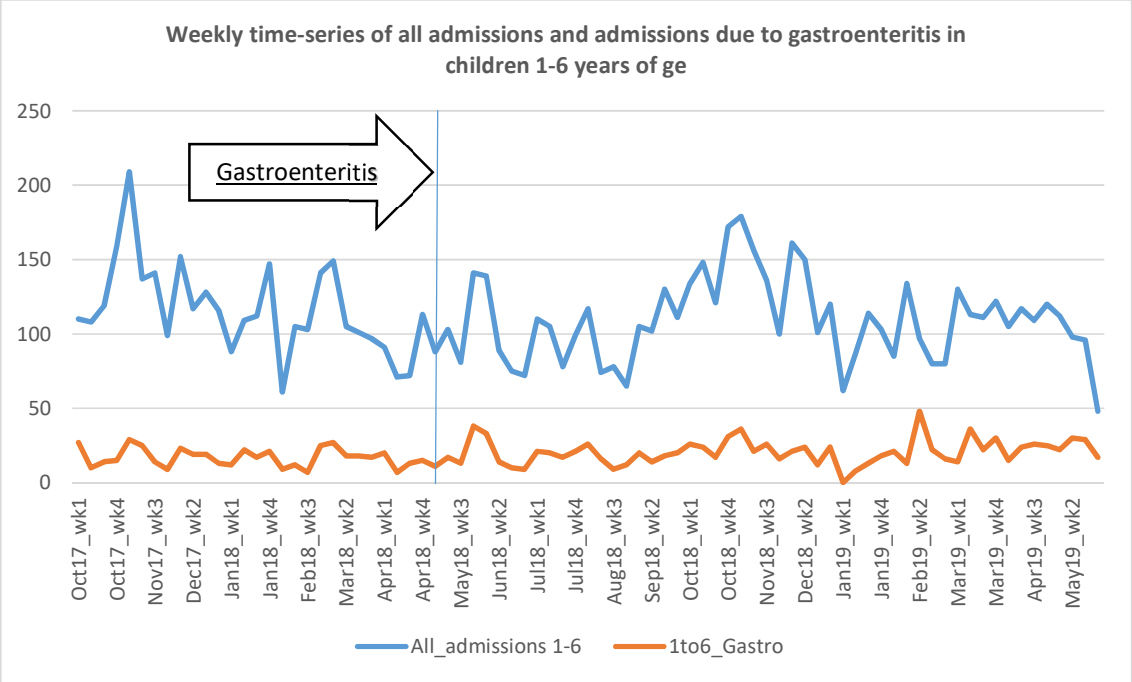
It is possible that children who were seen previously in hospital but were not officially admitted were now included on EPR which would increase the numbers of admissions/A&E visits, or could be that once EPR started, BRI also continued to extract data from the old system/methods. Hence children were double counted for this period. Some issues with training on introduction of EPR were also reported by the data management team at BHIR that could have possibly led to spikes. These should then have smoothed out over time, but the rate would not be expected to return to baseline as there are subsequent differences in the way admissions are coded post-EPR.

This sudden rise in admissions after introduction of the EPR system has affected our ability to evaluate the ACE pathways as this change was only three months before the implementation of the first ACE pathway. This leaves us with one quarterly or three monthly time-series pre-intervention for Wheezy Child Pathway evaluation, which in both cases is significantly below the recommended numbers required for these type of analyses. We further explored if weekly time-series can be used for this evaluation. Below we present weekly time-series (week 1-8 pre-intervention, 9-12 intervention wash-out period and 13-81 post-intervention) of all and asthma admissions in 2-16 year old children. We excluded all admissions prior to EPR implementation. Week-1 below is 1st week of October 2017 and wheezy Child Pathway was launched on week-9 (1st week of December). Number of asthma admissions per weekly time-series ranged from 29-82 pre-intervention and 2-77 post-intervention.



Numbers per weekly time-series were not sufficient to allow a robust evaluation of Wheezy Child Pathway. Similarly, for the evaluation of gastroenteritis pathway, number of admissions in weekly time-series were sparse. Below is the weekly time-series of gastroenteritis admissions (in 1-6 year olds as this was the target age group for gastroenteritis pathway). The pathway was launched on

the 1st week of May 2018. Gastroenteritis admissions per weekly time-series ranged from 7-29 pre-intervention and from 0-48 post-intervention.



Due to insufficient number of admissions in weekly time series and inadequate number of monthly (seven) and quarterly (two) time-series pre- gastroenteritis pathway, we could not evaluate it using this methodology.

Accident & Emergency

From BTHFT, we received data on 285934 A&E visits between January 2012 and March 2018. After removing visits in over 16 year olds, the remaining visits were 284160 of which only 17 visits were among children under 1 year of age. This dataset had no diagnostic codes included. Although, we performed some exploratory analysis on the data, it could not be used for the evaluation because of missing diagnosis codes. We also received data extracted from the 'Warehouse' which included diagnoses and treatment codes but reliability of those data was of concern for e.g. we received multiple extracts of these data on several occasions and the total number of A&E visits and trends over time in these data changed markedly and were never comparable with raw SUS extract. Hence, we were not able to analyse those data.

CONCLUSION

It not possible to evaluate the impact of ACE pathways using the currently available data due to the impact of the introduction of EPR on the data collected. The wider data for Y & H was not collected after the implementation of the ACE programme therefore also could not be used to evaluate this intervention.

This is a real issue not only for quantitative evaluation of the ACE programme but also has broader implications for researchers/data analysts/scientists using HES/SUS data from Bradford spanning the time when EPR was being implemented. We understand that there is great variation in the type and use of EPR system between geographical regions and sometimes even between departments within a hospital. Since the health data have endless secondary uses for research, any study involving analyses of routine NHS data spanning this time will need consideration of the impact EPR might have on the outcome/s of interest. Nonetheless, quasi-experimental evaluations could potentially be used in future, for bronchiolitis and jaundice pathways using for e.g. Difference-in-Difference approach to assess the change in average length of stay between intervention and potential comparator groups post-intervention. This will require identifying a suitable comparator while assessing parallel trends assumption.

Assessment of parallel trends assumption for Wheezy Child Pathway based on pre-intervention data from UoS suggests that pathway-specific age groups in the rest of Yorkshire & Humber could be a suitable comparator, hence ITSA with a comparator can be used for its impact evaluation. However, data post-intervention were not available for the rest of Yorkshire & Humber limiting our ability to apply this approach for Wheezy Child Pathway evaluation at this point. Similarly, due to limited number of time-series and insufficient admissions per time-series, we were not able to evaluate gastroenteritis pathway. If in future, data post-intervention for the rest of Yorkshire & Humber can become available, the parallel trends assumption can be graphically tested for potential comparators of various ACE pathways intervention groups. Although ITSA with a comparator is the most robust of the quasi-experimental designs, ITSA without a comparator group given the recommended number of time-series and observations can still provide a robust estimate. Or else, if there is a suitable comparator but time-series are not sufficient, Difference-in-Difference can be a useful approach for future evaluations.

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APPENDIX

Codes used for case identification

AWC

A&E Diagnosis codes:

251, 251228

ICD-10 codes

'J44', 'J441', 'J45', 'J450','J451','J458', 'J459', 'J4593', 'J46', 'J46X', 'J47X',

'R062','R06.2', 'J44.1', 'J441-', 'J44x', 'J45.0','J45.1','J45.8', 'J45.9','J46.X'

Nebulisation treatment code:

'251', '251228',

Gastroenteritis

A&E Diagnosis codes:

262, 262248, 263
ICD-10 codes
'262','262248', '263', 'K52', 'P783','A00','A000', 'A001', 'A009', 'A00.0', 'A00.1', 'A00.9', 'A01', 'A010', 'A011', 'A012', 'A013', 'A014', 'A01.0',
'A01.1', 'A01.2', 'A01.3', 'A01.4','A02','A020', 'A021', 'A022', 'A028', 'A029', 'A02.0', 'A02.1', 'A02.2', 'A02.8', 'A02.9', 'A03', 'A030', 'A031', 'A032', 'A033', 'A038','A039', 'A03.0', 'A03.1', 'A03.2', 'A03.3', 'A03.8', 'A03.9', 'A04', 'A040', 'A041', 'A042', 'A043', 'A044', 'A045', 'A046', 'A047', 'A048', 'A049','A04.0', 'A04.1', 'A04.2', 'A04.3', 'A04.4', 'A04.5', 'A04.6', 'A04.7', 'A04.8', 'A04.9', 'A05', 'A050', 'A051', 'A052', 'A053', 'A054', 'A058', 'A059', 'A05.0','A05.1', 'A05.2','A05.3', 'A05.4', 'A05.8', 'A05.9', 'A06','A060', 'A061', 'A062', 'A063', 'A069', 'A06.0', 'A06.1', 'A06.2','A06.3', 'A06.9', 'A07', 'A070', 'A071', 'A072', 'A073', 'A078', 'A079','A07.0', 'A07.1', 'A07.2', 'A07.3', 'A07.8', 'A07.9', 'A08', 'A080', 'A081', 'A082','A083', 'A084', 'A085', 'A08.0', 'A08.1', 'A08.2','A08.3', 'A08.4', 'A08.5', 'A09', 'A090', 'A099',
'A09.0',A09.9','R100','R101','R102','R103','R1033','R104','R11X','R13X','R14X','R15X','R160', 'R162','R17X','R18X','R190','R192','R194','R195','R198'

Croup
A&E diagnosis codes:

N/A

ICD-10 codes

J05, J050, J051, B95, B98, J209

Bronchiolitis

A&E diagnosis codes:

N/A

ICD-10 codes:

'J21', 'J210', 'J211', 'J218', 'J219', 'J111', 'J22X'**Jaundice**

A&E diagnosis codes:

N/A

ICD-10 codes:

R17 (Unspecified jaundice), P59, P590, P591, P592, P593, P598, P599, D580, P580, P581, P582, P583, P584, P585, P588, P589- (Neonatal jaundice)