Insights from and limitations of data linkage studies: analysis of short stay urgent admission referral source from routinely collected Scottish data

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ABSTRACT

Introduction. This study identified the referral source for urgent short stay admissions (SSA) and compared characteristics of children with a SSA stratified by different referral sources.

Methods. Routinely acquired data from urgent admissions to Scottish hospitals during 2015-2017 were linked to data held by the three referral sources: emergency department (ED), out of hours service (OOH), and general practice (GP).

Results. There were 171,039 admissions including 92,229 (54%) SSA. Only 171 (19%) of all of Scotland's GP practices contributed data. Among the subgroup of 10,588 SSA where GP data were available (11% all SSA) there was contact with the following referral source on the day of admission: only ED 1,853 (18%), only GP 3,384 (32%), only OOH 823 (8%). Additionally, 2,165 (20%) had contact with more than one referral source and 1,037 (10%) had contact with referral source(s) on the day before the admission. When all 92,229 SSA were considered, those with an ED referrer were more likely to be for older children, of white ethnicity, living in more deprived communities, and diagnosed with asthma, convulsions or croup. The odds ratio for an SSA for a given condition differed by referral source and ranged from 0.07 to 1.9 (with reference to ED referrals).

Conclusion. This study yielded insights and potential limitations regarding data linkage in a healthcare setting. Data coverage, particularly from primary care needs to improve further. Evidence from data linkage studies can inform future intervention designed to provide safe integrated care pathways.

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What is already known on this topic

Urgent short stay hospital admissions are rising in the UK. Interventions designed to safely slow the

rise in admissions need to understand pathways of care from home to hospital bed, e.g. which

referral sources refer which children.

What this study adds

This study demonstrates how national linkage of routinely acquired data can give insight into

pathways of care leading to an urgent admission, but also reveals the current limitations . Insights

include knowledge of the child's interaction(s) with referral sources prior to a short stay admission,

and characteristics of children admitted via different referral sources. An important limitation is that

"in hours" general practice information was missing for many individuals.

How this study might affect research, practice or policy

Access to routine primary care activity data would benefit care pathway research. Research based

on data linkage studies could be used to inform future interventions which change practice and

provide safe integrated care pathways.

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INTRODUCTION

Urgent hospital admissions for children have risen in the UK over the last 20 years (1,2), particularly

in infants(3). Short stay admissions (SSA), defined here as a hospitalisation where admission and

discharge occurred on the same day, explain most of the rise in urgent admissions. (4, 5)   Managing

acutely unwell children in the community, instead of a hospital ward, and enabling them to stay at

home has been suggested as an alternative to admission (6), but it is not clear which interventions

delivered where and by whom might safely reduce urgent admissions. (7)

Interventions could be delivered at the initial point of contact between the patient and healthcare

services and/or between referral service and inpatient facility (i.e. hospital). In the UK prior to an

urgent admission, patients contact an assessment and referral service based in either the emergency

department (ED), general practice (GP) during working hours, and out-of-hours primary care outside

working hours (OOH). In Scotland, the NHS24 service provides 24-hour telephone advice to the

public, which may include referral to ED, GP, OOH or the ambulance service; NHS24 cannot refer

directly to paediatric services

Better understanding of the referral pathways might provide evidence which could inform future

intervention designed to provide safe integrated urgent care pathways between home and

paediatric admission. Data linkage, where information on a given individual held by different data

sources is connected through a unique identifier, can describe care pathways for large populations

at a national level.

Our multidisciplinary group designed the FLAMINGO project (**FL**ow of **A**d**M**issions in ch**I**ldren and

you**NG** pe**O**ple) a mixed methods study to understand care pathways for urgent care for children.

FLAMINGO has three phases; phase one, described here, linked databases from ED, GP, OOH, NHS24

and a database holding details of hospital admissions to map care pathways and identify

characteristic referral pathways for SSAs. Phase two involved qualitative interviews from parents

and health professionals. Phase three was a stakeholder engagement which prioritised possible

interventions identified during phase two. Phases two and three will be reported separately.

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METHODS

Study design

Data from the following five clinical services were linked: Hospital admission details (Scottish Morbidity Record 01, SMR01); Out-of-Hours, Emergency Department and NHS 24 (all within the Unscheduled Care Datamart, UCD); general practice data (provided by Albasoft, an NHS trusted third party). The period of was 2015-2017 and was determined by the availability of data from UCD (beginning April 2014) and the onset of the study (2019). A referral source was defined as the location (ED, GP, OOH or combinations thereof) where the child had a clinical record for the day of admission. When there was contact with more than one referral source on the day of admission, sources were placed in chronological order where possible (time of GP contact was not provided in the majority of records). When no referral source was identified we took two additional approaches (i) contact with a referral source the day before admission was sought (ii) we determined whether the child had been discharged from hospital on the same day as admission or the day before ("open access admissions"). Our linkage methodology is described in the supplement.

Setting

NHS Scotland has 14 geographically distinct health boards each responsible for healthcare provision to their region's population. Two health boards (Lothian, and Greater Glasgow and Clyde) have ED facilities staffed by paediatricians but in all other health boards, staff trained in emergency medicine see children in an ED. Three health boards have no very limited in-patient paediatric facilities (Orkney, Shetland and Western Isles) and no data from these boards were included in this analysis. Four health boards have children's hospitals (Greater Glasgow and Clyde, Grampian, Lothian, and Tayside). Supplementary table one describes characteristics of the health boards.

Participants

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Individuals <16 years with ≥ one urgent admission to hospital under the care of a medical paediatric team in Scotland in the calendar years 2015-2017. Children seen in and discharged from the ED or admitted under paediatric surgical, orthopaedic or dental teams were ineligible.

Ethical approval

The study was approved by the Public Benefit and Privacy Panel for Health and Social Care (reference 1718-0183). Data were analysed in the National Data Safe Haven of Scotland (8), a secure repository accessed through a virtual private network by trained researchers.

Data sources

Scottish Morbidity Record 01, SMR01. (9) The SMR01 data are assessed for quality and completeness and are estimated to be 99% complete as of March 2018. (10) Data provided were: sex; ethnic group; decimal age; date of admission; date of discharge; admission type (emergency or elective); Scottish Index of Multiple Deprivations (SIMD) quintile; up to six ICD-10 diagnoses; Health Board of admission; specialty (paediatric medicine, paediatric surgery or paediatric dentistry). Time of admission was not available. Supplemental table two lists the ethnicity categories available.

Unscheduled Care Datamart (ED, OOH and NHS24 data). This resource provides data from ED, OOH and NHS 24 (the latter including the Scottish Ambulance Service). All records have a valid CHI number. (11) Supplemental table three presents details of all the variables provided.

GP Data (Albasoft). GP data were made available through NHS Trusted Third Party (Albasoft) using a previously described method. (12) Briefly all Scottish general practices have software potentially accessible by Albasoft and practices can opt in and consent to share data with researchers via Albasoft. Typically, 15-20% of practices agree to provide data. (12) Where records were available, Read codes were used to distinguish clinical contact leading to a referral from administrative entries arising from clinical contact (e.g. a letter from ED after presenting there). Supplemental table three presents details of all the variables provided.

Bias

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Completeness of data for SMR01 and the UCD ensures no bias. GP data were only available after

practices opted in and this may introduce bias.

Study size

The study size was all individuals aged <16 years with an urgent admission to hospitals in Scotland in

the calendar years 2015-2017.

Statistics

Descriptive statistics are provided for comparisons between groups. Multivariate logistic models

were used to compare odds ratio (OR) for the ten most common composite diagnoses stratified by

referral source. Composite diagnosis was defined as a group of very similar conditions, e.g.

"asthma" included International Classification of Disease (ICD)-10 code J45.0 (predominantly allergic

asthma), J45.9 (other and unspecified asthma) and J46X (Status Asthmaticus). (5) The benefit of

using composite diagnoses is that they minimise the potential for variations in coding between units.

(13) Supplemental table four describes how the composite diagnoses were derived. The following

accounted for 46.4% of all urgent admissions in Scotland 2000-2013 (5): asthma, bronchiolitis,

convulsion (including febrile and afebrile convulsions), croup, gastroenteritis, upper respiratory tract

infection (URTI), viral infection, tonsillitis, lower respiratory tract infections (LRTI) and admissions

with a diagnosis of cough or wheeze or shortness of breath. A stringent p value of <0.001 was used

to indicate a meaningful association since the sample size was so large. Standard statistical software

was used for the analysis (IBM® SPSS® version 24).

RESULTS

Linkage

There were 177,566 urgent admissions in 107,609 children, including 6,527 with two admissions

occurring on the same day and leaving 171,039 admissions for analysis of which 92,229 (54%) were

SSA (figure 1). GP data were available from 171 practices (19% of all in Scotland). Contact with any

referrer (ED, GP, OOH) was identified in 97,177 (57%) of all admissions, and 10,588 (78%) SSA where

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GP data were available. The ten composite diagnoses accounted for 89,489 (52%) of all admissions and 47,889 (52%) of SSA. Table one compares characteristics of different admission categories.

Referrers of SSA (subset where GP data were available)

There were 10,588 SSA (11% all SSA) where GP data were available, and of these there was contact with an NHS referrer on the day of admission with: ED in 1,853 (18%); GP in 3,384 (32%); OOH in 823 (8%), more than one referrer in 2,165 (20%). Additionally 1,037 (10%) with no contact with an NHS referrer on the day of admission had contact with ≥1 referrer the day before admission, and five had been discharged from hospital the same or the previous day.

Referrers for all SSA (whole dataset)

Among all 92,229 SSA, accepting that GP data were missing in the majority of cases, there was contact with only ED in 29,461 (32%), only GP in 3,384 (4%), only OOH in 7,569 (8%) admissions. Additionally there were 5,459 (6%) SSA with more than one contact on the date of admission and 12,182 (13%) SSA with no contact on the date of admission but with at least one referrer contact the day before the admission. There were 3,137 (3%) admissions with no referrer who had been discharged on the same date as admitted (n=1,420) or the previous day (n=1,717).

Referrers for all urgent admissions (including SSA)

Contact with a referrer was identified for 97,177 (57%) of the 171,039 urgent admissions. There was contact with only ED in 62,875 (37%), only OOH in 16,074 (9%) or only GP in 4,984 (3%) admissions; an additional 13,244 (8%) had contact with more than one referral source on the same day as admission (figure one). Among the 73,862 admissions (43% all admissions) with no contact with an NHS referrer on the day of admission there were: 18,061 (11% all admissions) where there was contact with a referrer on the day before admission, including 194 with GP, 5,033 with OOH (median time of arrival 21:04), 10,044 with ED (median time of arrival 21:04) and 2,790 with more than one

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contact (supplemental table five). An additional 7,569 (4% all admissions) with no NHS referrer were

discharged the same (n=43,377) or the previous day (n=3,192), and 775 had contacted NHS24 on the

day of admission (including 249 directed to their GP and 118 given self-care advice).

Characteristics of children with SSA stratified by referrers

Compared to those referred by OOH and GP, children referred by ED were older, more likely to be

ethnically white, from the most deprived communities and to have asthma, convulsions, croup and

less likely to have bronchiolitis or gastroenteritis (table two). Children admitted with Upper

Respiratory tract infection (URTI), viral infection, lower respiratory tract infection (LRTI) and

tonsillitis were most commonly referred by OOH (table two). These differences in characteristics for

children with SSA were observed when all admissions were considered (supplemental table six).

When compared to all children (supplemental table six), characteristics of infants with a SSA

(supplemental table seven) were similar when stratified by referral source (with the exception of

age).

Referrers for short stay admission for ten most common composite diagnoses

Relative to a referral from ED for a SSA, the odds ratio (OR) for a child with a given composite

diagnosis being referred for a SSA from OOH, GP or combination of referrers varied between 0.07

and 2.0 (table three). These findings were similar when all admissions were considered; of note the

OR for OOH referral for LRTI fell from 1.54 for SSA to 1.09 for all admissions (supplemental table

eight).

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DISCUSSION

This national data linkage study has identified both insights and the current limitations to understanding pathways of care for all patients with urgent illnesses. Insights from our linkage study include the observation that approximately 20% of SSA followed more than one contact with a NHS referral service on the day of the admission. Children's characteristics including ethnicity, deprivation, and a diagnosis of asthma, convulsions or croup differ when stratified by referral source.

Our study identified a number of limitations to linkage of currently available data. The main limitation is that data from 80% of GP practices were not available, this limitation has been observed previously (12). Despite this, we still had GP data for more than 10,000 admissions so were able to gain some understanding of patterns of primary care referral in care pathways. Comparing subgroups with GP data to the whole population – there were similarities in children: referred from OOH (8% versus 8%); seen in ED or OOH the previous evening (10% versus 13%); gender, age, deprivation and most diagnoses. Some differences were observed: children with GP data were less likely to be of White European ethnicity, have asthma as a diagnosis and were more likely to be from the most affluent quintile compared to the whole population. The findings in tables 2 and 3 should be interpreted cautiously, since the majority of GP data are missing, and could be due to chance. Changes in policy (and possibly funding) are required to enable linkage of a complete primary care dataset.

An additional limitation of the available data was that missing details on the time of hospital admission and GP attendance were missing, meaning that we could not determine whether ED or OOH contact occurred before or after the admission or GP contact. Understanding care pathways would also be enhanced by integration with data from non-healthcare sources, e.g. education and social care, but this is not currently possible. These limitations are considerable but could be addressed.

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A limitation to our study is that results are inevitably historical by the time of publication.

Additionally plus the COVID-19 pandemic may have further altered the relevance of the findings to

current practice. One solution to this would be to publish real time data, and this is done in some

UK nations. The UK Health Security Agency publish English ED, GP and OOH activity which is updated

on a weekly basis (14) and the Public Health Scotland publish ED and admission data with a one-

month lag (15); however neither of these resources link data together, e.g. admission and ED. The

most recent data from Scotland (15) show how ED attendance and hospital admissions in under-

fives and 5-14 year olds between July 2021 and April 2022 are comparable to the same period in

2018-19, so we believe that our data from 2015-17 are still relevant to NHS Scotland in 2022.

Our study did not consider diagnoses beyond the ten most common composite diagnoses, but these

contributed to 52% of all admissions and considering additional diagnoses would involve smaller

number of individuals whose results could be difficult to interpret meaningfully. An additional

limitation to our study is that the results may not necessarily be generalisable to all UK nations.

However although the number of admissions per head of population is slightly higher in England (16

than Scotland (5) the proportions referred from different sources may still be comparable.

Our results could be interpreted as suggesting that targeted interventions to the urgent care

pathway that focus on specific diagnoses, e.g. seizures, or patient characteristics, e.g. deprivation,

could be evaluated for their effect on SSA. However we describe associations where reverse

causation may be present. For example, convulsions are predominantly referred from ED since this is

where most cases present and many deprived communities have relatively fewer GPs (17) and thus

are more likely to present to ED.

Qualitative and stakeholder involvement findings from our research will be reported separately but,

when combined with these quantitative findings, will enhance understanding of complex settings

and pathways of care. FLAMINGO's whole body of work will contribute to a debate around targeted

or universal interventions to address the rising short-stay admission problem, and inform the design

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of future interventions for safe urgent care from a parent and health professional perspective. The

evidence for effective interventions to avoid SSAs is poor(7) and pragmatic randomised controlled

trials are required to investigate whether alternative care pathways can safely reduce SSA.

Contributorship statement

ST, RK, EF, CM, LA, PW and PH conceived the idea. SD, LA and ST undertook the quantitative work.

CM, EK, EF and PH undertook the qualitative work. ST wrote the first draft of the manuscript. All

authors made important contributions to revisions of the paper and have seen the final submitted

version. ST is the guarantor of the work.

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Table one. Comparison of characteristics of children with all admissions, short stay admissions (SSA) and those with admission for more than one day (i.e. not SSA).

		All admissions (n=171039)	Short stay admissions* (n=92229)	One day admissions (n=47703)	Admissions for more than one day (n=31107)	GP data available (n=19082)
	% (n) Male	55.5 (94908)	55.8 (51501)	55.9 (26676)	53.8 (16731)	54.8 (104610
	Median age (IQR), y	2.2 (0.7, 6.0)	2.2 (0.7, 5.8)	2.4 (0.9, 6.1)	2.0 (0.4, 6.4)	2.1 (0.5, 6.0)
	% (n) White European	69.2 (11820)	68.3 (63029)	69.6 (33202)	70.9 (22059)	63.1 (12050)
	Median SIMD (IQR)	3 (1, 4)	3 (1, 3)	3 (1, 4)	3 (1, 4)	3 (2, 4)
% (n) in each deprivation quintile	SIMD 1 (most deprived)	27.0 (45586)	27.4 (25022)	26.7 (12584)	26.0 (7980)	23.4 (4460)
	SIMD 2	22.1 (37275)	22.1(20118)	22.3 (10493)	21.7 (6664)	20.8 (3953)
	SIMD 3	19.6 (33105)	19.3 (17612)	19.9 (9374)	19.9 (6119)	18.1 (3447)
	SIMD 4	17.8 (30024)	18.0 (16405)	17.1 (8057)	18.1 (5562)	19.9 (3793)
	SIMD 5 (least deprived)	13.6 (23403)	13.2 (12032)	14.0 (6589)	14.4 (4422)	17.7 (3370)
% (n) for each of the top ten composite diagnoses	Asthma	3.2 (5450)	2.3 (2148)	4.0 (1920)	4.4 (1382)	2.1 (394)
	Bronchiolitis	8.5 (14466)	6.8 (6295)	8.1 (3842)	13.9 (4329)	7.8 (1480)
	Convulsion	2.7 (4577)	2.5 (2320)	3.3 (183)	2.2 (674)	2.3 (447)
	Croup	2.5 (4355)	3.0 (2799)	2.7 (1307)	0.7 (229)	2.6 (493)
	Gastroenteritis	5.6 (9514)	6.2 (5698)	5.9 (2799)	3.3 (1017)	6.1 (1159)
	URTI	7.0 (11943)	8.9 (8165)	6.2 (2964)	2.6 (814)	6.7 (1286)
	Viral infection	11.5 (19708)	11.1 (10236)	14.7 (6997)	8 (2475)	11.3 (2149)
	Lower Respiratory Tract Infection	3.9 (6743)	2.8 (2552)	3.7 (1777)	7.8 (2414)	3.4 (651)
	Cough/Wheeze/Shortness of Breath	4.2 (7120)	4.3 (3970)	4.7 (2230)	3.0 (920)	4.2 (802)
	Tonsillitis	3.3 (5633)	4.0 (3706)	3.0 (1415)	1.6 (512)	3.3 (631)
% (n) for each Health Board Providing care	Ayrshire and Arran	11.5 (19583)	13.9 (12797)	9.1 (4341)	7.9 (2445)	9.2 (1758)
	Borders	2.8 (4799)	3.0 (2739)	3.0 (1407)	2.1 (653)	0.2 (33)
	Dumfries and Galloway	3.4 (5827)	2.7 (2471)	3.8 (1820)	4.9 (1536)	0.1 (17)
	Fife	4.2 (7171)	2.9 (2680)	5.3 (2529)	6.3 (1962)	2.2 (626)
	Forth Valley	6.5 (11063)	5.7 (5236)	7.7 (3647)	7.0 (2180)	4.8 (907)

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	Grampian	10.0 (17016)	9.5 (8794)	10.5 (4989)	10.4 (3233)	18.9 (3612)
	Greater Glasgow and Clyde	20.0 (34159)	20 (18400)	21.3 (10137)	18.1 (5622)	17.9 (3420)
	Highland	5.3 (9000)	6.3 (5784)	3.8 (1829)	4.5 (1387)	10.7 (2040)
	Lanarkshire	12.7 (21682)	14.9 (13768)	11.6 (5527)	11.0 (2387)	7.4 (1403)
	Lothian	12.8 (21777)	9.5 (8707)	14.6 (6930)	19.8 (6140)	15.2 (2891)
	Tayside	10.9 (18681)	11.7 (10749)	9.3 (4442)	11.2 (3490)	12.4 (2370)

*Short stay admission defined as where the child is admitted and discharged on the same date

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Table two. Characteristics of children with a short stay admission (i.e. admitted and discharged on the same date) for an acute medical admissions stratified by referral source.

		All short stay day admissions with referrer identified (n=45,873)	Referred by GP (n=3,384)	Referred by OOH (n=7,569)	Referred by ED (29,461)	Seen by both GP and OOH* (n=243)	Seen by both GP-ED* (n=1,478)	Referred by OOH, earlier ED assessment (n=346)	Referred by ED after earlier OOH assessment (n=3,300)	Seen by all three* (n=92)	Referrer not known (n=46,356)
	% (n) Male	55.7 (25572)	55.6 (1881)	54.7 (4144)	56.0 (16485)	58.0 (141)	54.0 (798)	58.1 (201)	56.5 (1863)	64.1 (59)	55.9 (25929)
	Median age (IQR), y	2.26 (0.88-5.56)	2.1 (0.57-6.03)	1.91 (0.77-4.59)	2.41 (0.97-5.92)	1.6 (0.59-4.67)	2.3 (0.89-6.4)	2.13 (0.85-6.09)	2.02 (0.81-4.66)	1.6 (0.38-3.78)	2.08 (0.59-6.0)
	% (n) White European	69.4 (31850)	56.4 (1910)	63.0 (4769)	72.5 (21360)	57.6 (140)	67.7 (1001)	60.9 (209)	72.9 (2405)	60.9 (56)	67.3 (31179)
	Median SIMD	2 (1-4)	3 (2-4)	3 (2-4)	2 (1-4)	3 (2-4)	2 (1-4)	3 (2-4)	2 (1-4)	2 (1-4)	3 (1-4)
SIMD	SIMD 1 (most deprived)	29.9 (13620)	18.0 (607)	24.7 (1860)	32.3 (9440)	17.4 (42)	33.1 (489)	23.6 (81)	32.6 (1074)	30.0 (27)	25.0 (11402)
	SIMD 2	22.4 (10195)	19.3 (650)	22.0 (1655)	22.9 (6685)	18.6 (45)	20.4 (301)	19.0 (65)	23.5 (773)	23.3 (21)	21.8 (9923)
	SIMD 3	18.0 (8219)	21.1 (712)	20.3 (1530)	17.3 (5051)	26.4 (64)	15.4 (228)	22.4 (77)	16.4 (540)	18.9 (17)	20.6 (9393)
	SIMD 4	17.0 (7773)	23.4 (790)	19.7 (1484)	15.5 (4540)	21.1 (51)	17 (251)	23.3 (80)	17.1 (563)	15.6 (14)	18.9 (8632)
	SIMD 5 (least deprived)	12.7 (5797)	18.1 (610)	13.4 (1010)	12.1 (3539)	16.5 (40)	14 (207)	11.7 (40)	10.3 (340)	12.2 (11)	13.7 (6235)
Top ten conditions	Asthma	2.5 (1148)	1.7 (56)	2.3 (175)	2.7 (797)	0.8 (2)	1.8 (27)	0.9 (3)	2.5 (84)	4.3 (4)	2.2 (1000)
	Bronchiolitis	6.8 (3101)	8.4 (285)	8.0 (603)	6.0 (1776)	10.3 (25)	7.2 (106)	3.2 (11)	8.7 (286)	9.8 (9)	6.9 (3194)
	Convulsion	3.7 (1680)	0.7 (22)	0.6 (46)	5.1 (1500)	0.4 (1)	4.9 (72)	2.3 (8)	0.9(31)	0	1.4 (640)
	Croup	3.8 (1740)	1.9 (65)	3.6 (273)	4.0 (1167)	5.8 (14)	4.5 (66)	3.5 (12)	4.2 (137)	6.5 (6)	2.3 (1059)
	Gastroenteritis	6.3 (2885)	6.1 (207)	9.0 (681)	5.3 (1553)	8.2 (20)	6.5 (96)	8.1 (28)	8.8 (289)	12.0 (11)	6.1 (2813)
	URTI	9.7 (4456)	8.4 (285)	11.6 (881)	8.9 (2612)	10.7 (26)	8.8 (130)	12.4 (43)	14.3 (471)	8.7 (8)	8.0 (3709)
	Viral infection	12.1 (5545)	11.7 (395)	14.5 (1095)	11.2 (3309)	9.9 (24)	12.1 (179)	13.3 (46)	14.8 (490)	7.6 (7)	10.1 (4691)
	Lower Respiratory Tract Infection	2.6 (1178)	3.1 (104)	3.4 (255)	2.3 (680)	4.5 (11)	2.0 (29)	1.2 (4)	2.9 (95)	0	3.0 (1374)

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	Cough/Wheeze/ Shortness of Breath	4.5 (2083)	4.4 (149)	4.6 (350)	4.5 (1325)	2.9 (7)	4.4 (65)	4.0 (14)	4.9 (163)	10.9 (10)	4.1 (1887)
	Tonsillitis	4.2 (1933)	4.8 (161)	5.7 (435)	3.6 (1064)	7.0 (17)	4.3 (64)	6.1 (21)	5.1 (168)	3.3 (3)	3.8 (1733)
Health Board	Ayrshire and Arran	24.2 (11066)	1.3 (43)	0.6 (45)	30.3 (8914)	0	30.4 (449)	4.9 (17)	47.6 (1569)	31.5 (29)	3.7 (1731)
	Borders	2.5 (1137)	0.1 (2)	5.4 (408)	2.2 (661)	0.4 (1)	0.1 (1)	13 (45)	0.5 (18)	1.1 (1)	3.5 (1602)
	Dumfries and Galloway	4.4 (2029)	0	0.1 (7)	5.9 (1741)	0	0	2.6 (9)	8.2 (271)	1.1 (1)	1.0 (442)
	Fife	1.8 (802)	0.6 (19)	3.5 (267)	1.6 (481)	0.8 (2)	0.3 (5)	4.3 (15)	0.4 (13)	0	4.1 (1878)
	Forth Valley	4.5 (2068)	4.2 (141)	8.5 (640)	4.0 (1189)	4.5 (11)	2.2 (32)	6.9 (24)	0.9 (28)	3.3 (3)	6.8 (3168)
	Grampian	8.6 (3917)	20.5 (695)	10.8 (819)	6.4 (1888)	25.5 (62)	18.3 (270)	14.2 (49)	3.7 (123)	12.0 (11)	10.5 (4877)
	Greater Glasgow and Clyde	24.5 (11233)	13.3 (451)	15.8 (1196)	28.3 (8312)	21.4 (52)	28.1 (415)	10.7 (37)	22.6 (743)	29.3 (27)	15.5 (7167)
	Highland	5.0 (2304)	19.3 (653)	7.6 (578)	30.0 (881)	17.7 (43)	5.9 (87)	4.3 (15)	1.4 (45)	2.2 (2)	7.5 (3480)
	Lanarkshire	8.6 (3945)	12.9 (437)	18.6 (1408)	6.6 (1954)	10.3 (25)	3.7 (55)	5.2 (18)	1.5 (48)	0	21.1 (9823)
	Lothian	7.9 (3602)	7.5 (255)	13.7 (1039)	7.0 (2052)	9.1 (22)	6.7 (99)	9.8 (34)	2.9 (95)	6.5 (6)	11 (5105)
	Tayside	8.1 (3700)	20.3 (688)	15.3 (1161)	4.5 (1325)	10.3 (25)	4.4 (65)	24 (83)	10.4 (341)	13 (12)	15.2 (7049)

*Time of seeing GP was not available for most cases meaning it is not possible to say who the final referral source was.

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Table three. The odds ratio of an admission with one of the top ten most common composite diagnoses stratified by source of referral, for short stay admissions. The logistic regression model adjusted for sex, age, ethnicity, deprivation, health board and day and month of admission.

	Emergency Department	Out of Hours	General Practice	More than one contact	No referral source identified
Asthma	Reference n=797	0.91 (0.76, 1.09) n=175	0.61 (0.46, 0.81) p=0.001 n=56	0.97 (0.79, 1.18) n=120	0.71 (0.64, 0.80) p<0.001 n=1000
Bronchiolitis	Reference n=1779	1.17 (1.04, 1.32) p=0.009 n=603	1.14 (0.98, 1.33) n=285	1.31 (1.16, 1.48) p<0.001 n=437	0.82 (0.76, 0.89) p<0.001 n=3194
Convulsion	Reference n=1500	0.07 (0.06, 0.10) p<0.001 n=46	0.09 (0.06, 0.13) p<0.001 n=22	0.39 (0.32, 0.48) p<0.001 n=112	0.18 (0.17, 0.20) p<0.001 n=640
Croup	Reference n=1167	0.67 (0.58, 0.77) p<0.001 n=273	0.43 (0.33, 0.55) p<0.001 n=65	1.02 (0.88, 1.19) n=235	0.46 (0.42, 0.51) p<0.001 n=1059
Gastroenteritis	Reference n=1553	1.92 (1.73, 2.14) p<0.001 n=681	1.28 (1.10, 1.50) p=0.002 n=207	1.52 (1.36, 1.71) p<0.001 n=444	1.24 (1.16, 1.34) p<0.001 n=2813
URTI	Reference n=2612	1.43 (1.30, 1.57) p<0.001 n=881	1.14 (0.99, 1.30) n=285	1.35 (1.23, 1.48) p<0.001 n=678	0.99 (0.93, 1.05) n=3709
Viral infection	Reference n=3309	1.25 (1.15, 1.35) p<0.001 n=1095	0.93 (0.83, 1.05) n=395	1.28 (1.17, 1.40) p<0.001 n=746	0.81 (0.77, 0.86) p<0.001 n=4691
Lower Respiratory Tract Infection	Reference n=680	1.54 (1.31, 1.82) p<0.001 n=255	1.20 (0.96, 1.49) n=104	1.17 (0.97, 1.41) n=139	1.22 (1.10, 1.36) p<0.001 n=1374
Cough, Wheeze or Shortness of Breath	Reference n=1325	1.20 (1.05, 1.37) p=0.006 n=350	1.07 (0.89, 1.28) n=149	1.12 (0.97, 1.29) n=259	1.04 (0.96, 1.12) n=1887
Tonsillitis	Reference n=1064	1.77 (1.55, 2.01) p<0.001	1.46 (1.22, 1.75) p<0.001	1.41 (1.23, 1.63) p<0.001	1.07 (0.97, 1.17) n=1773

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		n=435	n=161	n=273	

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Figure one. A diagram explaining how the referral source for the 171,039 urgent hospital admissions of children aged <16 years to hospitals in Scotland in the calendar years 2015-2017 was identified by linkage of routinely acquired data. The percentages in brackets were calculated with reference to either 171,039 (for all admissions) or 92,229 (for short stay admissions, SSA). *contacted on the same day as the admission, some admissions occurred after contact with more than one referrer. †Data available for 19% of practices. Data from ED and OOH were >99% complete. ED=Emergency Department, GP=General Practitioner, OOH=Out-of-Hours general practice. ‡ for SSA where no referrer was identified on the day of admission there were 12,182 who had contacted at least one referred the day before admission and 3,137 who had been discharged the same or the previous day**.**

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│ ≥ One admission on a single day n=171,039    │
│ 92,229 (54%) short stay admissions (SSA)      │
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│ Any referrer │  │ ED contact on│  │ GP contact on│  │ OOH contact  │
│ contacted*?  │  │ the date of  │  │ the date of  │  │ on the date  │
│              │  │ admission    │  │ admission†   │  │ of admission │
│              │  │ n=77,596     │  │ n=9,360      │  │ n=25,814     │
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│ Final        │  │ ED           │  │ GP*          │  │ OOH          │
│ referrer?    │  │ n=62,857     │  │ n=4,984 (3%) │  │ n=16,074 (9%)│
│              │  │ (37%)        │  │ SSA=3,384    │  │ SSA=7569 (8%)│
│              │  │ SSA=29,461   │  │ (4%)         │  │              │
│              │  │ (32%)        │  │              │  │              │
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│ Contact with >1      │  │ Unknown referrer source†,        │
│ referrer prior to    │  │ n=73,862 (43%) including 18,061   │
│ admission            │  │ (11%) who contacted ≥ one         │
│ n=13,244 (8%)        │  │ referrer the day before          │
│ SSA=5,459 (6%)       │  │ admission and 7,569 (4%)          │
│                      │  │ discharged the same or the       │
│                      │  │ previous day‡                    │
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Figure one. A diagram explaining how the referral source for the 171,039 urgent hospital admissions of children aged <16 years to hospitals in Scotland in the calendar years 2015-2017 was identified by linkage of routinely acquired data. The percentages in brackets were calculated with reference to either 171,039 (for all admissions) or 92,229 (for short stay admissions, SSA). *contacted on the same day as the admission, some admissions occurred after contact with more than one referrer. †Data available for 19% of practices. Data from ED and OOH were >99% complete. ED=Emergency Department, GP=General Practitioner, OOH=Out-of-Hours general practice. ‡ for SSA where no referrer was identified on the day of admission there were 12,182 who had contacted at least one referred the day before admission and 3,137 who had been discharged the same or the previous day.
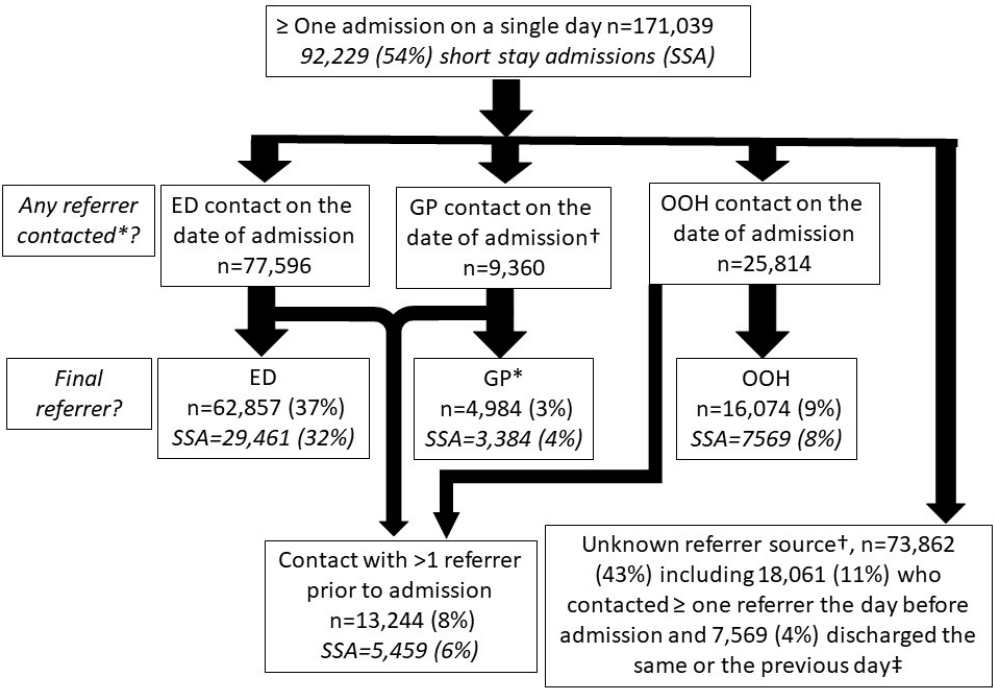
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Linkage methodology

Residents of Scotland have a unique Community Health Index number (CHI) enabling linkage of information across health services. A third party replaced

each CHI with a study specific identifier (SSI) to preserve anonymity. The same SSI was used for the same CHI in each database. Data for each individual

admission were linked deterministically using a variable which was square of the SSI multiplied by the numerical derivative of the date of admission. When

more than one admission occurred on the same day both were presumed to be related to the same illness and the second admission listed was deleted. A

small number (<10 for each database) of duplicate linkage identifiers were present; one was deleted, and the dates of referral and admission verified as

being the same for the remaining referral. In a step wise manner, the SMR01 file was then merged with the ED, OOH, GP and NHS24 files to create a master

file where there was one row for each hospital admission. NHS24 data were only analysed for admissions where no final referral source was identified.

Where no referral source was apparent, recognising that some early morning admissions could have been referred the previous evening, the linkage was

repeated to identify admissions where there was contact the previous day and the time of the contact noted.

Supplemental table one. Characteristics of the populations in each health board (a geographical area where a single organisation provides healthcare for the population). The three Scottish NHS boards with no paediatric in patient facility are not included in this table (NHS Orkney, NHS Shetland and NHS Western Isles). Deprivation was expressed by quintile of the Scottish Index of Multiple Deprivations (SIMD). IQR=interquartile range. ED=emergency Department. GP=General Practitioner

NHS health board	Average number of <16 year old children 2015-2017	Area covered by NHS Health board in square miles (children/square mile)	Median SIMD quintile (IQR, 1=most deprived)	Median age at admission (IQR)	Health board details (number of hospitals, children's hospital, paediatric ED, referral to ED from GPs, etc)
NHS Ayrshire and Arran	62038	1,310 (47)	2 (1,3)	2.4 (0.8, 6.3)	One hospital with inpatient paediatric facilities. GPs often refer patients to ED instead of direct to paediatric services
NHS Borders	18999	1,831 (10)	3 (2,4)	3.1 (1.0, 8.1)	One hospital with inpatient paediatric facilities
NHS Dumfries and Galloway	23592	2,400 (10)	3 (2,4)	2.3 (0.7, 6.7)	One hospital with inpatient paediatric facilities.
NHS Fife	64262	512 (125)	2 (1,4)	2.5 (0.8, 6.0)	One hospital with inpatient paediatric facilities.
NHS Forth Valley	52836	1,020 (52)	3 (2,4)	3.0 (1.0, 7.8)	One hospital with inpatient paediatric facilities.
NHS Grampian	99483	3,360 (30)	3 (2,4)	2.0 (0.6, 5.7)	Two hospitals with inpatient paediatric facilities, one of which is a dedicated paediatric hospital but whose ED is staffed by ED clinicians (not paediatricians).
NHS Greater Glasgow and Clyde	194416	453 (429)	2 (1,3)	1.9 (0.6, 5.3)	One dedicated paediatric hospital with inpatient paediatric facilities, with an ED is staffed by paediatricians
NHS Highland	53059	12,507 (4)	3 (2,4)	2.2 (0.6, 6.0)	One hospital with inpatient paediatric facilities
NHS Lanarkshire	118165	883 (134)	2 (1,3)	2.4 (0.8, 6.5)	One hospital with inpatient paediatric facilities
NHS Lothian	148356	700 (186)	3 (2,4)	1.8 (0.5, 4.5)	Two hospitals with inpatient paediatric facilities, one of which is a dedicated paediatric hospital whose ED is staffed by paediatricians.
NHS Tayside	67872	2,986 (23)	3 (1,4)	2.6 (0.9, 6.7)	One dedicated paediatric hospital with inpatient paediatric facilities, with an ED is staffed by paediatricians

Supplemental table two. Description of the ethnic group categorisation in the Scottish Morbidity Record 01 database, taken from the Office of National Statistics Harmonised Standards **(https://gss.civilservice.gov.uk/wp-content/uploads/2016/03/P3-Ethnic-Group-June-16-1.pdf)**

Ethnic group	Ethnic group of background
White	Scottish Other British Irish Gypsy / Traveller Polish Other
Mixed	Any mixed or multiple ethnic group
Asian, Asian Scottish or Asian British	Pakistani, Pakistani Scottish or Pakistani British Indian, Indian Scottish or Indian British Bangladeshi, Bangladeshi Scottish or Bangladeshi British Chinese, Chinese Scottish or Chinese British Other
African	African, African Scottish or African British Other
Caribbean or Black	Caribbean, Caribbean Scottish or Caribbean British Black, Black Scottish or Black British Other
Other	Arab, Arab Scottish or Arab British Other

Supplemental table three. Variables available from the Unscheduled Care Datamart (providing data from emergency department, out of hours and NHS24) and from Albasoft (providing data from general practice). Scottish Index of Multiple Deprivations=SIMD.

Referral source	Variables provided
Emergency Department	Arrival date; Arrival Time; Age; Referral Source; Attendance category description; Discharge type description; Discharge destination description; Referral to (up to 3) description; Discharge code[1]; Diagnosis description and Diagnosis text (for up to 3 diagnoses).
Out of Hours	Date; Time; Age; Clinician Type (Nurse/ Doctor); Diagnosis code (Read Codes[2]); Diagnosis description; Referral source; Case Outcome; Drug Prescribed.
NHS 24	Call date; Call time; Call type code; Call type description; Call original code; Call original description; Outcome of call code; Outcome of call description; Outcome of call Group.
General practice	Date; distance from practice to nearest hospital; distance from practice to nearest hospital with paediatric inpatient facilities; Age; Sex; SIMD decile; Urban-Rural code[3]; Booked; Appointment time; Read Code.1; Read Code.2; Read Code.3; Free text description.1; Free text description.2; Free text description.3; Prescription by BNF code.1; Prescription by BNF code.2; Prescription by BNF code.3

[1]https://www.ndc.scot.nhs.uk/Dictionary-A-Z/Definitions/index.asp?Search=D&ID=215&Title=Diagnosis%20(AandE)
[2]https://digital.nhs.uk/services/terminology-and-classifications/read-codes
[3]Scottish Government Urban Rural Classification 2016 - gov.scot (www.gov.scot)

Supplemental table four. How the most common ten composite diagnoses were defined using individual diagnoses categorised in the International Categorisation of Disease-10 (ICD-10).

Condition/condition group	ICD-10 code	Description
Asthma	J45.0	Predominantly allergic asthma
	J45.9	Other and unspecified asthma
	J46X	Status Asthmaticus*
Bronchiolitis	J21.0	Acute bronchiolitis due to respiratory syncitial virus
	J21.8	Acute bronchiolitis due to other specified organisms
	J21.9	Acute bronchiolitis unspecified
	J12.1	Respiratory syncitial virus pneumonia
Convulsion	G40.9	Epilepsy unspecified
	R56.8	Unspecified convulsions
	R56.0	Febrile convulsions
Croup	J05.0	Acute obstructive laryngitis [croup]
Gastroenteritis	A08.0	Rotavirus
	A08.1	Norwalk virus
	A08.2	Adenovirus
	A08.3	Other virus enteritis
	A08.4	Viral intestinal infection unspecified
	A09.0	Infectious gastroenteritis and colitis unspecified
	A09.9	Gastroenteritis and colitis of unspecified origin
	A09X	Infectious gastroenteritis and colitis, unspecified
	K52.9	Non infectious gastroenteritis and colitis
Upper respiratory tract infection	J06.9	Acute upper respiratory tract infection, unspecified
	J00X	Acute nasopharyngitis
Viral infection	B34.9	Viral infection, unspecified
Tonsillitis	J03.9	Acute tonsillitis unspecified
	J02.9	Acute pharyngitis, unspecified
	J03.8	Acute tonsillitis due to other organisms
	J03.0	Streptococcal tonsillitis
Lower respiratory tract infection	J12.0*	Adenoviral pneumonia
	J12.2*	Parainfluenza virus pneumonia

	J12.8*	Other viral pneumonia
	J12.9*	Viral pneumonia unspecified
	J13X*	Pneumonia due to Streptococcus pneumoniae
	J14X*	Pneumonia due to Haemophilus influenzae
	J15.1*	Pneumonia due to Pseudomonas
	J15.2*	Pneumonia due to Staphylococcus
	J15.4*	Pneumonia due to other streptococci
	J15.7*	Pneumonia due to Mycoplasma pneumoniae
	J15.8*	Pneumonia due to other specified bacteria
	J15.9*	Unspecified bacterial pneumonia
	J18.0*	Bronchopneumonia unspecified organism
	J18.1*	Lobar pneumonia, unspecified organism
	J18.1D*	Lobar pneumonia with pleural effusion
	J18.8*	Other pneumonia with effusion
	J18.9*	Pneumonia, unspecified organism
	J22X*	Unspecified acute lower respiratory infection
Cough, wheeze or shortness of breath	R05X	Cough
	R06.2	Wheezing
	R06.0	Dyspnoea
	R06.8	Other abnormalities of breathing

Supplemental table five.   Characteristics of all children admitted to hospital with those with contact on the day before but not on the day of their hospital admission, stratified by referral source.

		All admissions to hospital with contact on the day before admission (n=18061)	GP only (n=194)	OOH only (n=5033)	ED only (n=10044)	GP-OOH (n=19)	GP-ED (n=127)	ED-OOH (n=193)	OOH-ED (n=2437)	All three (n=14)
%Male		54.8 (9905)	51.5 (100)	53.8 (2708)	55.1 (5537)	78.9 (15)	63.8 (81)	59.1 (114)	55.1 (1344)	42.9 (6)
Median age (IQR)		2.34 (0.79-6.55)	1.54 (0.34-5.34)	2 (0.68-5.38)	2.76 (0.95-7.87)	1.12 (0.15-6.69)	2.18 (0.61-7.2)	2.29 (0.84-6.25)	1.88 (0.61-4.95)	1.47 (0.42-6.16)
%White European		70.9 (12801)	62.4 (121)	67.2 (3384)	72.8 (7317)	63.2 (12)	66.1 (84)	69.9 (135)	71.6 (1744)	28.6 (4)
Median SIMD (IQR)		2 (1-4)	3 (2-4)	3 (1-4)	2 (1-4)	2 (1-4)	3 (1-4)	3 (2-4)	2 (1-4)	1 (1-2.75)
% (n) in each Deprivation Quintile	SIMD 1 (most deprived)	29.9 (5373)	11.9 (23)	26.2 (1313)	31.2 (3111)	31.6 (6)	25.4 (32)	21.9 (42)	34.6 (838)	57.1 (8)
	SIMD 2	22 (3957)	17.5 (34)	23.1 (1160)	21.6 (2156)	21.1 (4)	19 (24)	25 (48)	21.8 (528)	21.4 (3)
	SIMD 3	18.6 (3338)	24.2 (47)	20.7 (1038)	18 (1796)	15.8 (3)	19 (24)	16.7 (32)	16.4 (398)	0
	SIMD 4	16.1 (2891)	25.3 (49)	17.6 (883)	15.4 (1533)	21.1 (4)	21.4 (27)	123.4 (45)	14.4 (350)	0
	SIMD 5 (least deprived)	13.4 (2399)	21.1 (41)	12.3 (619)	13.8 (1379)	10.5 (2)	15.1 (19)	13 (25)	12.8 (311)	21.4 (3)
% (n) by month of admission	Jan	7.9 (1423)	9.3 (18)	9.4 (471)	7.2 (724)	10.5 (2)	6.3 (8)	7.8 (15)	7.6 (185)	0
	Feb	7.7 (1382)	7.2 (14)	8.1 (406)	7.7 (775)	10.5 (2)	7.1 (9)	6.7 (13)	6.7 (163)	0
	Mar	9.1 (1652)	9.3 (18)	9.6 (484)	8.7 (876)	15.8 (3)	7.9 (10)	14 (27)	9.6 (233)	7.1 (1)
	Apr	7.8 (1402)	6.2 (12)	8 (405)	7.7 (773)	21.1 (4)	7.1 (9)	6.7 (13)	7.5 (182)	28.6 (4)
	May	8.2 (1477)	4.6 (9)	8.2 (415)	8.4 (839)	0	11 (14)	11.9 (23)	7.3 (177)	0
	Jun	7.1 (1277)	7.7 (15)	7.2 (361)	7.1 (712)	10.5 (2)	8.7 (11)	6.7 (13)	6.6 (160)	21.4 (3)
	Jul	5.8 (1055)	5.7 (110	5.5 (276)	6.1 (616)	0	3.1 (4)	5.7 (11)	5.6 (136)	7.1 (1)
	Aug	6.9 (1248)	4.1 (8)	5.4 (274)	7.8 (780)	10.5 (2)	3.9 (5)	5.2 (10)	6.9 (168)	7.1 (1)
	Sep	8.3 (1495)	8.2 (16)	7 (351)	8.7 (876)	0	7.1 (9)	6.2 (12)	9.5 (231)	0
	Oct	8.7 (1576)	7.7 (15)	8.5 (427)	8.8 (888)	5.3 (1)	8.7 (11)	7.8 (15)	8.9 (218)	7.1 (1)

	Nov	11.2 (2021)	10.3 (20)	11 (553)	11.3 (1138)	0	18.1 (23)	9.8 (19)	10.9 (266)	14.3 (2)
	Dec	11.4 (2053)	19.6 (380	12.1 (610)	10.4 (10470	15.8 (3)	11 (140	11.4 (22)	13 (318)	7.1 (1)
% (n) by day of admission	Mon	17.3 (3125)	5.2 (10)	21.7 (1090)	14.6 (1468)	15.8 (3)	12.6 (16)	20.7 (40)	20.3 (495)	21.4 (3)
	Tue	14.6 (2638)	22.2 (43)	14.1 (708)	15 (1511)	10.5 (2)	18.9 (24)	16.1 (31)	13 (318)	7.1 (1)
	Wed	14.5 (2612)	19.6 (38)	13.7 (692)	15.2 (1525)	15.8 (3)	18.1 (23)	11.9 (23)	12.6 (306)	14.3 (2)
	Thu	13.3 (2408)	16 (31)	12.5 (630)	13.8 (1389)	21.1 (4)	15.7 (20)	9.3 (18)	13 (316)	0
	Fri	12.7 (2296)	21.1 (41)	11.5 (577)	13.7 (1373)	15.8 (3)	9.4 (12)	11.9 (23)	11.1 (271)	14.3 (2)
	Sat	12.4 (2235)	13.9 (27)	11 (556)	13.4 (134)	15.8 (3)	9.4 (12)	11.9 (23)	11.1 (271)	14.3 (2)
	Sun	15.2 (2747)	2.1 (4)	15.5 (780)	14.3 (1437)	5.3 (1)	14.2 (18)	18.7 (36)	19.1 (466)	35.7 (5)
% (n) with top ten conditions	Asthma	3.8 (691)	2.1 (4)	2.8 (140)	4.2 (418)	0	0.8 (1)	3.6 (7)	4.9 (120)	7.1 (1)
	Bronchiolitis	8.7 (1577)	16 (31)	8.4 (425)	7.9 (794)	15.8 93	14.2 (18)	11.4 (22)	11.5 (280)	28.6 (4)
	Convulsion	2.9 (519)	0	0.4 (18)	4.7 (475)	0	7.9 (10)	0.5 (1)	0.6 (15)	0
	Croup	3.8 (687)	4.1 (8)	3.3 (166)	4.2 (426)	5.3 (1)	2.4 (3)	2.1 (4)	3.2 (79)	0
	Gastroenteritis	6 (1084)	5.7 (11)	9.4 (475)	4.1 (410)	0	3.1 (4)	8.8 (17)	6.8 (166)	7.1 (1)
	URTI	6.2 (1122)	2.1 (4)	8.3 (418)	4.9 (495)	5.3 (1)	3.1 (4)	6.7 (13)	7.6 (186)	7.1 91
	Viral infection	12.3 (2224)	8.2 (16)	14.2 (713)	10.5 (1052)	5.3 (1)	9.4 (120	7.3 (14)	16.9 (413)	21.4 (3)
	Lower Respiratory Tract Infection	4 (719)	5.7 (110	3.4 (172)	4 (406)	5.3 (1)	2.4 (30	5.7 (11)	4.7 (115)	0
	Cough/Wheeze/ Shortness of Breath	3.7 (663)	1.5 (3)	3.4 (173)	3.8 (378)	0	2.4 (3)	2.6 (5)	4.1 (101)	0
	Tonsillitis	3.4 (617)	2.6 (5)	5.4 (272)	2.3 (234)	0	0.8 (1)	6.7 (13)	3.8 (92)	0
% (n) from each health Board	Ayrshire and Arran	7.3 (1308)	0.5 (1)	0.5 (25)	9 (898)	0	1.6 (2)	2.1 (4)	15.5 (378)	0
	Borders	1.4 (250)	0	2.4 (122)	1.1 (111)	0	0	5.7 (11)	0.2 (6)	0
	Dumfries and Galloway	1.7 (303)	0	0.1 (5)	2.1 (208)	0	0	1 (2)	3.6 (88)	0
	Fife	6.5 (1167)	0.5 (1)	8.8 (443)	6.6 (664)	0	0	15 (29)	1.2 (30)	0
	Forth Valley	5.5 (9.5)	1.5 (3)	6.4 (3240	6.2 (6210	0	0	4.1 (8)	1.6 (39)	0
	Grampian	8.1 (1469)	32 (62)	12.8 (644)	6.4 (642)	42.1 (8)	22.8 (29)	14 (27)	2.3 (56)	7.1 (1)

Greater Glasgow and Clyde	24.5 (4417)	8.8 (17)	9.2 (465)	27.8 (2785)	26.3 (5)	29.1 (37)	9.3 (18)	44.4 (1079)	78.6 (11)
Highland	5.2 (932)	30.4 (59)	7.8 (395)	4.1 (407)	10.5 (2)	15 (19)	5.7 (11)	1.6 (39)	0
Lanarkshire	14.3 (2576)	10.3 (200	26.6 (1339)	11.4 (1143)	10.5 (2)	6.3 (8)	11.9 (23)	1.7 (41)	0
Lothian	17 (3062)	7.2 (14)	9 (452)	20.2 (2020)	10.5 (2)	25.2 (32)	9.3 (18)	21.5 (522)	14.3 (2)
Tayside	8.6 (1555)	8.8 (17)	16.3 (818)	5.2 (525)	0	0	21.8 (42)	6.3 (153)	0

Supplemental table six. Characteristics of children with all acute medical admissions stratified by referral source.

		All admissions with known referral source (n=97177)	GP only (n=4984)	OOH only (n=16074)	ED only (n=62875)	GP-OOH (n=553)	GP-ED (n=3534)	ED-OOH (769)	OOH-ED (n=8099)	All three (n=289)	Referral source unknown (n=73862)
%Male		55.5 (53971)	55.3 (2754)	54.8 (8803)	55.7 (35040)	57.1 (316)	54.4 (1923)	56.2 (432)	56 (4533)	58.8 (170)	55.4 (40937)
Median age (IQR)		2.27 (0.84-5.75)	2.19 (0.52-6.45)	1.93 (0.73-4.92)	2.41 (0.92-6.09)	1.76 (0.57-5.06)	2.25 (0.73-6.12)	2.25 (0.81-6.4)	2.03 (0.76-4.79)	1.66 (0.45-4.53)	2.09 (0.53-6.28)
%White European		70.3 (68347)	57.4 (2860)	63.5 (10215)	73 (45896)	57 (315)	68.6 (2424)	62.3 (479)	73.5 (5956)	69.9 (202)	67.6 (49943)
Median SIMD (IQR)		2 (1-4)	3 (2-4)	3 (2-4)	2 (1-4)	3 (2-4)	2 (1-4)	3 (2-4)	2 (1-4)	2 (1-4)	3 (2-4)
% (n) in each Deprivation Quintile	SIMD 1 (most deprived)	28.8 (27786)	17.4 (863)	24.7 (3946)	30.6 (19086)	15.4 (85)	29.5 (1041)	20.8 (159)	31.2 (2520)	30 (86)	24.6 (17800)
	SIMD 2	22.2 (21478)	19.4 (963)	22.3 (3573)	22.4 (13982)	19.4 (107)	20.7 (728)	20.9 (160)	23.5 (1897)	23.7 (68)	21.8 (15797)
	SIMD 3	18.7 (18042)	21.2 (1053)	20.2 (3232)	18.3 (11445)	23.9 (132)	16 (565)	23.2 (177)	17.2 (1392)	16 (46)	20.8 (15063)
	SIMD 4	16.8 (16269)	23.4 (1163)	19.1 (3055)	15.7 (9771)	20.5 (113)	16.9 (595)	22.8 (174)	16.7 (1345)	18.5 (53)	19 (13755)
	SIMD 5 (least deprived)	13.5 (13031)	18.6 (924)	13.7 (2200)	13.1 (8150)	20.8 (115)	16.9 (596)	12.3 (94)	11.4 (918)	11.8 (34)	13.8 (10012)
	Jan	8.6 (8385)	8.7 (433)	9.5 (1530)	8.3 (5207)	11 (61)	8.5 (299)	9 (69)	9.4 (758)	9.7 (28)	8.2 (6092)
	Feb	8.4 (8211)	9 (451)	7.8 (1259)	8.5 (5372)	9 (50)	9.7 (342)	7.5 (58)	8.1 (655)	8.3 (24)	8.2 (6086)
	Mar	9.2 (4712)	9.4 (150)	9.5 (810)	9.1 (3045)	12.3 (38)	10.1 (208)	13.2 (56)	8 (383)	11.2 (22)	9.3 (6867)
	Apr	7.6 (7349)	7.3 (362)	8.5 (1371)	7.3 (4573)	7.6 (42)	7.6 (268)	8.5 (65)	8 (645)	8 (23)	7.5 (5510)
	May	8.4 (4332)	8.5 (136)	9.3 (791)	8.2 (2725)	8.1 (25)	8.6 (177)	11.1 (47)	8.8 (422)	4.6 (9)	8 (5930)
	Jun	7.2 (3714)	7.6 (121)	6.7 (568)	7.4 (2481)	7.7 (24)	6.6 (135)	7.6 (32)	7.1 (339)	7.1 (14)	7.3 (5356)
	Jul	5.9 (3016)	5.5 (88)	5.3 (451)	6.1 (2038)	4.5 (14)	5.4 (110)	5.7 (24)	5.8 (276)	7.6 (15)	6 (4405)

% (n) by month of admission	Aug	6.6 (6407)	6.3 (314)	5.2 (829)	7.1 (4434)	4.9 (27)	6.1 (215)	6.9 (53)	6.4 (521)	4.8 (14)	7 (5149)
	Sep	8.8 (4511)	8.8 (141)	8 (682)	9 (2994)	9.4 (29)	9 (185)	7.1 (30)	9 (432)	9.1 (18)	8.2 (6030)
	Oct	8.6 (4390)	7 (112)	8.5 (722)	8.7 (2903)	8.1 (25)	8.3 (170)	7.3 (31)	8.6 (413)	7.1 (14)	8.5 (6252)
	Nov	10.7 (5498)	10.4 (166)	10.6 (898)	10.8 (3597)	12.3 (38)	12.6 (260)	7.3 (31)	10.1 (485)	11.7 (23)	10.7 (7888)
	Dec	10.4 (10098)	11.2 (557)	11.4 (1839)	10.1 (6235)	8.3 (46)	8.9 (314)	10.5 (81)	11.2 (910)	9 (26)	11.2 (8297)
% (n) by day of admission	Mon	15.1 (14686)	19.3 (963)	11.7 (1876)	16.2 (10179)	12.3 (68)	17.7 (627)	13.9 (107)	10.2 (830)	12.5 (36)	18.2 (13464)
	Tue	13.9 (13510)	18.4 (918)	8.7 (1391)	15.4 (9707)	9.9 (55)	18.4 (649)	10.9 (84)	8.2 (668)	13.1 (38)	16.3 (12047)
	Wed	13.3 (12941)	19.2 (958)	7.7 (1245)	15.1 (9472)	10.8 (60)	16.4 (578)	7.8 (60)	6.7 (543)	8.7 (25)	17.1 (12637)
	Thu	13.3 (12932)	19.3 (961)	7.7 (1234)	14.9 (9393)	12.7 (70)	18 (635)	7.7 (59)	6.9 (555)	8.7 (25)	17.1 (12607)
	Fri	13.4 (12980)	19.3 (961)	8.2 (1312)	14.9 (9365)	13.2 (73)	16.8 (594)	8.1 (62)	7.3 (593)	6.9 (20)	16.6 (12254)
	Sat	14.9 (14501)	2.1 (104)	26.6 (4279)	11.3 (7125)	20.1 (111)	6.1 (215)	24.7 (190)	29.8 (2412)	22.5 (65)	7 (5168)
	Sun	16.1 (15627)	2.4 (119)	29.5 (4737)	12.1 (7634)	21 (116)	6.7 (236)	26.9 (207)	30.8 (2498)	27.7 (80)	7.7 (5685)
% (n) with top ten conditions	Asthma	3.5 (3375)	1.8 (88)	2.9 (472)	3.8 (2365)	1.6 (9)	2.5 (89)	2.1 (16)	4 (325)	3.8 (11)	2.8 (2075)
	Bronchiolitis	8.5 (8258)	8.9 (442)	8.8 (1419)	8.1 (5099)	9.4 (52)	9.1 (323)	5.9 (45)	10.4 (839)	13.5 (39)	8.4 (6208)
	Convulsion	3.6 (3460)	0.7 (33)	0.5 (81)	4.9 (3085)	0.7 (4)	4.6 (161)	1.8 (14)	1 (80)	0.7 (2)	1.5 (1117)
	Croup	3 (2921)	1.7 (86)	2.9 (463)	3 (1899)	3.3 (18)	3.4 (120)	3.1 (24)	3.7 (300)	3.8 (11)	1.9 (1414)
	Gastroenteritis	5.7 (5562)	5.9 (293)	8.6 (1379)	4.7 (2937)	8.1 (45)	5.2 (185)	7 (54)	8 (644)	8.7 (25)	5.4 (3952)
	URTI	7.4 (7194)	7.1 (354)	9.4 (1503)	6.6 (4167)	9.2 (51)	6.1 (217)	9.1 (70)	10.1 (816)	5.5 (16)	6.4 (4749)
	Viral infection	12.9 (12565)	11.2 (556)	14.9 (2400)	12.2 (7651)	13.4 (74)	12.3 (436)	12 (92)	16.4 (1325)	10.7 (31)	9.7 (7143)
	Lower Respiratory Tract Infection	3.9 (3826)	3.9 (194)	4.1 (659)	3.9 (2440)	4.7 (26)	3.7 (129)	2.9 (22)	4.3 (348)	2.8 (8)	3.9 (2917)
	Cough/Wheeze/ Shortness of Breath	4.5 (4328)	4.3 (213)	4.8 (778)	4.3 (2732)	2 (11)	3.8 (134)	4.2 (32)	5 (407)	7.3 (21)	3.8 (2792)
	Tonsillitis	3.4 (3344)	3.9 (196)	5 (802)	2.9 (1807)	6.7 (37)	3.1 (110)	5.1 (39)	4.3 (346)	2.4 (7)	3.1 (2289)
	A&A	17.7 (17130)	1.2 (60)	0.5 (86)	21.3 (13325)	0.2 (1)	18.2 (643)	4.2 (32)	36.1 (2929)	2.1 (64)	3.3 (2453)
	Borders	2.3 (2196)	0.1 (4)	4.8 (778)	2 (1250)	0.5 (3)	0.1 (5)	12.5 (96)	0.7 (59)	0.3 (1)	3.5 (2603)
	D&G	5.1 (4936)	0	0.1 (16)	6.5 (4072)	0	0 (1)	3.9 (30)	10.1 (815)	0.7 (2)	1.2 (891)

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% (n) from each health Board	Fife	2.9 (2843)	1.8 (89)	5.3 (846)	2.8 (1759)	2.9 (16)	0.7 (23)	5.6 (43)	0.8 (64)	1 (3)	5.9 (4328)
	Forth Valley	5.5 (5317)	4.9 (243)	10.8 (1743)	4.8 (3006)	6.5 (36)	2.1 (74)	8.3 (64)	1.8 (145)	2.1 (6)	7.8 (5746)
	Grampian	11.8 (34)	23.1 (1153)	11.7 (1879)	6.6 (4148)	28.6 (158)	17.4 (614)	16.3 (125)	4.2 (341)	11.8 (34)	11.6 (8564)
	GGC	24 (23234)	11.8 (587)	13.4 (2151)	27.6 (17313)	16.8 (93)	24.8 (876)	9.9 (76)	25.6 (2065)	25.3 (73)	14.8 (10925)
	Highland	3.9 (3752)	17.6 (877)	6.4 (1036)	2.4 (1483)	12.8 (71)	4.6 (162)	3.6 (28)	1.1 (89)	2.1 (6)	7.1 (5248)
	Lanarkshire	8.3 (8020)	11.8 (587)	20.2 (3246)	6.2 (3864)	11.6 (64)	3.1 (108)	5.2 (40)	1.4 (110)	0.3 (1)	18.5 (13662)
	Lothian	13.8 (13421)	7.8 (390)	11.3 (1822)	15 (9426)	8 (44)	24.6 (871)	7.8 (60)	9.2 (741)	23.2 (67)	11.3 (8356)
	Tayside	7.9 (7654)	19.9 (994)	15.4 (2469)	4.8 (3033)	12.1 (67)	4.4 (157)	22.7 (174)	9 (728)	11.1 (32)	14.9 (11027)

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Supplemental table seven. Characteristics of infants (n=28087) with a short stay admission.

		All admissions for infants with known referral source (n=12606)	GP only (n=1143)	OOH only (n=2349)	ED only (n=7520)	GP-OOH (n=93)	GP-ED (n=405)	ED-OOH (n=98)	OOH-ED (n=962)	All three (n=36)	Referral source unknown (n=15481)
%Male		57.8 (7289)	58.4 (668)	59.5 (1397)	57.2 (4298)	60.2 (56)	54.8 (222)	55.1 (540	59 (568)	72.2 (26)	58.3 (9019)
Median age (IQR)		0.39 (0.16-0.69)	0.27 (0.1-0.58)	0.45 (0.21-0.71)	0.38 (0.16-0.69)	0.39 (0.18-0.7)	0.36 (0.15-0.66)	0.52 (0.25-0.75)	0.44 (0.21-0.44)	0.26 (0.15-0.51)	0.25 (0.08-0.59)
%White European		61.6 (7166)	46.1 (527)	53.6 (1260)	65.9 (4954)	48.4 (45)	60.5 (245)	60.2 (59)	68.7 (6610)	41.7 (15)	60.2 (9316)
Median SIMD (IQR)		2 (1-4)	3 (2-4)	3 (1-4)	2 (1-4)	3 (2-4)	2	2.5 (1-4)	2 (1-3)	2 (1.25-4)	3 (1-4)
% (n) in each Deprivation Quintile	*SIMD 1 (most deprived)*	31.6 (3959)	19.0 (216)	26.6 (623)	34.9 (2609)	17.4 (16)	33.0 (133)	26.0 (25)	34.2 (328)	25.0 (9)	26.0 (3982)
	SIMD 2	22.5 (2821)	16.6 (188)	22.7 (531)	23.2 (1735)	19.6 (18)	17.9 972)	24.0 (23)	25.4 (244)	27.9 (10)	22.3 (3416)
	SIMD 3	17.6 (2201)	23.0 (261)	20.0 (468)	16.2 91209)	28.3 (26)	16.1 (650	15.6 (15)	15.7 (151)	16.7 (6)	20.2 (3090)
	SIMD 4	16.5 (2062)	23.6 (2680	18.6 (4360	14.5 (1081)	20.7 (19)	18.1 973)	18.8 (18)	16.7 (160)	19.4 (7)	18.1 (2768)
	SIMD 5 (least deprived)	11.9 (1490)	17.8 (202)	12.1 (284)	11.2 (836)	14.1 (13)	14.9 (60)	15.6 (15)	7.9 (76)	11.1 (4)	13.3 (2042)
	Jan	9.5 (1201)	8.7 (100)	10.6 (2490	9.1 (6850	15.1 (14)	10.1 (41)	15.3 (15)	9.8 (94)	8.3 (3)	8.1 (1261)
	Feb	8.3 (1051)	7.6 (87)	6.3 (148)	9.1 (6850	4.3 (4)	10.6 (43)	4.1 (4)	8.1 (78)	5.6 (2)	7.8 (1298)
	Mar	7.9 (999)	9.4 (108)	8.3 (194)	7.7 (579)	7.5 (7)	9.4 (38)	7.1 (7)	6.7 (64)	5.6 (2)	8.4 (1298)
	Apr	7.5 (943)	6.7 (77)	8.3 (195)	7.5 (564)	1.1 (1)	6.2 (25)	8.2 (8)	7.2 (69)	11.1 (4)	7.6 (1173)

% (n) by month of admission	May	6.9 (871)	7 (80)	8 (189)	6.8 (508)	5.4 (5)	4.4 (18)	12.2 (12)	6.0 (58)	2.8 (1)	7.8 91203)
	Jun	6.9 (872)	7.3 (84)	6 (140)	7.2 (544)	9.7 (9)	6.9 (28)	5.1 (5)	6.0 (58)	11.1 (4)	6.9 (1074)
	Jul	6.8 (852)	5 (57)	7.1 (167)	6.6 (500)	6.5 (6)	7.7 (31)	4.1 (4)	8.5 (82)	14.9 (5)	6.5 (1002)
	Aug	6.1 (768)	6.5 (74)	4.3 (100)	6.7 (504)	5.4 (5)	4.9 (20)	4.1 (4)	6.0 (58)	8.3 (3)	6.6 (1019)
	Sep	7.9 (993)	7.6 (87)	7.6 (178)	7.9 (597)	6.5 (6)	7.4 (30)	7.0 (70)	9.0 (87)	2.8 (1)	7.9 (1216)
	Oct	9 (1135)	8.7 (99)	9.2 (215)	9.0 (676)	7.5 (7)	7.9 (32)	9.6 (92)	10.2 (10)	11.1 (4)	9.1 (1406)
	Nov	11.1 (1396)	11.6 (133)	11.2 (264)	10.9 (818)	21.5 (20)	12.3 (50)	10.2 (10)	10.2 (98)	8.3 (3)	11.1 (1738)
	Dec	12.1 (1525)	13.7 (157)	13.2 (310)	11.4 (860)	9.7 (9)	12.1 (49)	12.2 (12)	12.9 (124)	11.1 (4)	12.2 (1889)
% (n) by day of admission	Mon	15 (1888)	18.4 (210)	10.7 (251)	16.4 (1230)	10.8 (10)	17.3 (70)	18.4 (18)	10.0 (96)	8.3 (3)	17.5 (2713)
	Tue	1660 (13.2)	16 (183)	6.9 (162)	15.3 (1151)	10.8 (10)	17.8 (72)	9.2 (9)	7.3 (70)	8.3 (3)	15.3 92367)
	Wed	13.1 (1649)	20.4 (233)	6.4 (151)	15.1 (1138)	8.6 (8)	15.8 (64)	7.1 (7)	4.9 (47)	2.8 (1)	17.6 (2727)
	Thu	14.1 (1775)	20 (229)	7.7 (181)	16.1 (1213)	9.7 (9)	18.8 (76)	4.1 (4)	6 (58)	13.9 (5)	17.9 (2771)
	Fri	14.4 (1810)	20.8 (238)	6.8 (159)	16.4 (1232)	14 (13)	19.8 (80)	13.3 (13)	7.5 (72)	8.3 (3)	17.3 (2680)
	Sat	15 (1887)	2.3 (26)	30.8 (723)	9.9 (748)	22.6 (21)	4.4 (18)	21.4 (21)	33.8 (325)	13.9 (5)	7.1 (1128)
	Sun	15.4 (1937)	2.1 (24)	30.7 (722)	10.7 (808)	23.7 (22)	6.2 (25)	26.5 (26)	30.6 (294)	44.4 (16)	7.1 (1095)
% (n) with top ten conditions	Asthma	0 (4)	0	0	0.1 (4)	0	0	0	0	0	0 (2)
	Bronchiolitis	20.8 (2626)	21.7 (248)	22.1 (520)	19.7 (1485)	26.9 (25)	23 (93)	10.2 (10)	24.5 (236)	25 (9)	17.2 (2667)
	Convulsion	1.2 (149)	0.3 (4)	0.3 (6)	1.7 (130)	0	1 (4)	0	0.5 (5)	0	0.5 (78)
	Croup	2.5 (321)	1.6 (18)	2.4 (56)	2.8 (208)	1.1 (1)	2.5 (10)	6.1 (6)	2.3 (22)	0	1.5 (226)
	Gastroenteritis	6.1 (767)	4.5 (51)	8.5 (199)	5.3 (401)	9.7 (9)	5.4 (22)	5.1 (5)	7.9 (76)	11.1 (4)	4.9 (765)
	URTI	12 (1513)	9.4 (107)	13.3 (312)	11.5 (862)	14 (13)	9.6 (39)	17.3 (17)	16.5 (159)	11.1 (4)	8.6 (1330)
	Viral infection	6.6 (8260	5.9 967)	10.4 (245)	5.5 (417)	7.5 (7)	6.2 (25)	11.2 (11)	5.5 (53)	2.8 (1)	5.6 (873)
	Lower Respiratory Tract Infection	0.8 (99)	0.4 (5)	0.9 (20)	0.8 (63)	2.2 (2)	0.2 (1)	0	0.8 (8)	0	0.7 9113)

	Cough/Wheeze/ Shortness of Breath	5.6 (704)	5.1 (58)	4.8 (112)	6.2 (463)	3.2 (3)	5.9 (24)	4.1 (4)	3.6 (35)	13.9 (5)	4.6 (708)
	Tonsillitis	1.7 (220)	1.7 919)	2 (47)	1.7 (125)	1.1 (1)	1.2 (5)	3.1 (3)	2.1 (20)	0	1.3 (203)
% (n) from each health Board	Ayrshire and Arran	25.2 (3174)	1.4 (16)	0.6 (14)	33.4 (2511)	0	31.9 (129)	7.1 (7)	50.7 (487)	27.8 (10)	3.9 (597)
	Borders	1.6 (199)	0.1 (1)	4.4 (103)	1.1 (85)	0	0	4.1 (4)	0.6 (6)	0	2.7 (422)
	Dumfries and Galloway	4.8 9603)	0	0 (1)	6.8 (511)	0	0	4.1 (4)	9.1 (87)	0	0.9 (147)
	Fife	1.4 (181)	0.3 (3)	3.4 (80)	1.2 (91)	0	0.2 (1)	4.1 (4)	0.2 (2)	0	3.6 (552)
	Forth Valley	3.9 (489)	3.1 (360	8.3 (194)	3.1 (231)	6.5 (6)	1 (4)	10.2 (10)	0.7 (7)	2.8 (1)	5.8 9898)
	Grampian	9.5 (1195)	22.3 (255)	11.8 (278)	6.9 (518)	17.2 (16)	18.8 (76)	17.3 (17)	3.3 (32)	8.3 (3)	11.4 (1757)
	Greater Glasgow and Clyde	24.6 (3099)	14.5 (166)	17.4 (408)	28.5 (2143)	24.7 (23)	28.6 (116)	10.2 (10)	22.8 (219)	38.9 (14)	17.2 (2655)
	Highland	5.1 (648)	19.5 (223)	6.9 9161)	2.7 (203)	20.4 (19)	5.7 (23)	6.1 (6)	1.5 (14)	0	8 (1232)
	Lanarkshire	8.5 (1066)	12.9 (148)	17.9 (421)	6 (453)	15.1 (14)	2.5 (10)	6.1 (60	1.5 (14)	0	18.7 (2899)
	Lothian	8.1 (1023)	9 (1030	13.3 (313)	7 (528)	6.5 (6)	8.6 (350	9.2 99)	2.8 (27)	5.6 (2)	14.6 (2267)
	Tayside	7.3 (916)	16.8 (192)	16 (375)	3.1 (2360	9.7 (90	2.7 9110	21.4 (21)	6.9 (66)	16.7 (6)	13.2 (2049)

Supplemental table eight. The odds ratio of an admission with one of the top ten most common conditions stratified by source of referral, including all admissions. These ten conditions accounted for 52% of all unscheduled admissions. The logistic regression model adjusted for sex, age, ethnicity, deprivation, health board and day and month of admission.

	Emergency Department	Out of Hours	General Practice	More than one contact	No referral source identified
Asthma	Reference n=2365	0.85 (0.76, 0.94) p=0.003 n=472	0.50 (0.40, 0.63) p<0.001 n=88	1.05 (0.95, 1.17) n=450	0.71 (0.67, 0.76) p<0.001 n=2075
Bronchiolitis	Reference n=5099	0.95 (0.82, 1.02) n=1419	0.96 (0.85, 1.08) n=442	1.16 (1.07, 1.24) p<0.001 n=1298	0.80 (0.76, 0.84) p<0.001 n=6208
Convulsion	Reference n=3085	0.07 (0.06, 0.09) p<0.001 n=81	0.10 (0.07, 0.15) p<0.001 n=33	0.39 (0.34, 0.44) p<0.001 n=261	0.23 (0.22, 0.25) p<0.001 n=1117
Croup	Reference n=1899	0.77 (0.69, 0.86) p<0.001 n=463	0.52 (0.43, 0.66) p<0.001 n=86	1.12 (1.01, 1.24) p=0.038 n=473	0.55 (0.51, 0.59) p<0.001 n=1414
Gastroenteritis	Reference n=2937	1.99 (1.85, 2.14) p<0.001 n=1379	1.33 (1.17, 1.52) p<0.001 n=293	1.51 (1.40, 1.63) p<0.001 n=953	1.20 (1.14, 1.27) p<0.001 n=3952
URTI	Reference n=4167	1.50 (1.40, 1.60) p<0.001 n=1503	1.22 (1.09, 1.38) p=0.001 n=354	1.25 (1.17, 1.35) p<0.001 n=1170	1.03 (0.98, 1.08) n=4749
Viral infection	Reference n=7651	1.19 (1.12, 1.25) p<0.001 n=2400	0.87 (0.79, 0.96) p=0.005 n=556	1.26 (1.19, 1.33) p<0.001 n=1958	0.73 (0.70, 0.76) p<0.001 n=7143
Lower Respiratory Tract Infection	Reference n=2440	1.09 (0.99, 1.20) n=659	0.96 (0.82, 1.12) n=194	1.10 (1.00, 1.21) n=553	0.99 (0.93, 1.05) n=2917
Cough, Wheeze or Shortness of Breath	Reference n=2732	1.22 (1.11, 1.33) p<0.001 n=778	1.03 (0.89, 1.19) n=213	1.06 (0.97, 1.17) n=605	0.94 (0.89, 1.00) p=0.039 n=2792
Tonsillitis	Reference n=1807	1.75 (1.59, 1.92) p<0.001	1.41 (1.20, 1.65) p<0.001	1.43 (1.29, 1.58) p<0.001	1.04 (0.97, 1.11) n=2289

		n=802	n=196	n=539	