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Characteristics of Paediatric Attendances of the Emergency Department in a Major Irish Tertiary Referral Centre Before and After Expansion of Free GP Care to Children Under 6

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ABSTRACT

Objectives: To examine the characteristics of paediatric attendances to the Emergency Department (ED) in Cork University Hospital (CUH) before and after the expansion of free GP care to children under the age of 6 years.

Design: This is a retrospective observational study that used a large administrative dataset.

Setting: The study was conducted in major Irish tertiary referral centre that serves a total population of over 1.1 million. It is a public hospital, owned and managed by the Health Service Executive (HSE).

Participants: Children aged 0-15 years who attended CUH ED during the study period of 6 years (2012 – 2018) were included in this study (n = 76,831).

Interventions: Free GP care was expanded to all children aged 0-15 years in July 2015.

Main outcome measures: The characteristics of paediatric attendances to CUH ED were examined during 2 time periods: 3 years before the expansion of free GP care to children under 6 (July 1st 2012 – June 30th 2015) and 3 years after (July 1st 2015 – June 30th 2018). Changes in the mode of referral, i.e. GP referral, and inpatient hospital admissions through the CUH ED in the under 6s group were investigated.

Results: Overall paediatric presentations to CUH ED increased from 35,819 during the Time Period 1 to 41,012 during the Time Period 2 (14.5%). The proportion of the CUH ED attendances through GP referrals by children under 6s increased by over 8% ($p < 0.0001$) in the Time Period 2. The proportion of children in this age group who attended the CUH ED through GP referral and who were subsequently admitted to hospital, however, decreased by over 3% ($p < 0.0001$).

Conclusion: The expansion of free GP care has upstream health service utilisation implications, such as increased attendances at ED, and should be considered and costed by policy-makers.

What is known about the subject

- A growing rate of Emergency Department (ED) attendances, including paediatric presentations, that contribute to overcrowding of the emergency services is a global phenomenon.
- When medical care is free of charge, children and adolescents increase the number of doctor visits.
- A 25% increase in GP attendances by children aged under 6 years was observed in Ireland following the expansion of free GP care to this age group.

What this study adds

- A significant sustained increase in paediatric GP referrals to the ED of a major Irish tertiary referral centre was observed following the expansion of free GP care to children under 6 years.
- Despite the increase in paediatric GP referrals to Cork University Hospital (CUH) ED, the proportion of children under the age of 6 that were admitted to hospital decreased.
- The expansion of free GP care has upstream health service utilisation implications and must be considered by policy-makers.

INTRODUCTION

There is sufficient evidence that health in childhood has strong long-term impacts on socioeconomic status and adulthood health.[1-4] Making primary care more accessible should encourage children to seek medical attention when needed and hypothetically, improve the general population health long-term.

Currently, the majority of the Irish population pay out-of-pocket fees for their General Practitioner (GP) visits and these payments for primary care are the highest among the European Union countries.[5] In 2011 the Irish Government made a commitment to introduce Universal GP Care which guaranteed free GP care for all.[6] The roll out of free GP care for children under 6 years was the first step taken by the Government towards that goal.

On July 1st 2015 all children aged under 6 years became entitled to free GP care in Ireland. The introduction of the free GP care for children aged under 6 years was aligned with the national policy as described in the Future Health Strategic Framework and aimed to ensure effective, safe and high-quality health services for young children.[7]

GP referral is the preferred mode of accessing hospital services for acute presentations in Ireland. However, direct access to ED (by self-referral) is also available though this is discouraged by the charge of a fee of €100 if attending without a GP referral. This fee is also levied in respect of children attending ED.

It has been shown that when medical care is free of charge, children and adolescents increase the number of doctor visits by 5-10%.[3] A USA-based study that estimated the average association between outpatient and inpatient care, showed that expanded use of primary care, through insurance policy changes and improved access to primary care, was associated

with a greater number of hospital presentations and an increase in inpatient spending. It was noted that this was particularly the case for the conditions for which the decision to admit to hospital was potentially more at the discretion of the primary care physician. Thus, increased access to primary care does not always result in savings in secondary care as is often assumed it will.[8]

By December 2016, the number of children under the age of 6 years who were eligible for free GP care in Ireland doubled compared to December 2014.[9] At the same time, a 25% increase in GP attendances in this age group was reported.[10] There are clear indications that the Irish primary care system provided by GPs is already under pressure and may struggle to meet demand in the near future.[10-12] This might have implications for upstream health services, especially Emergency Departments (ED), which often serve as substitutes for primary care, though not designed for this type of work.

As the next phase of rolling out of Universal GP care has been recently announced by the Irish Government, with expansion of GP care without fees to 6 and 7 year-olds this year and further phased extension to all children aged under 13, it is important that all potential implications are considered.

This study aimed to investigate the impact of free GP care to children under the age of 6 years on the characteristics of paediatric attendances at Cork University Hospital (CUH) ED.

METHODS

This research was conducted in a major Irish tertiary referral centre and university training hospital. Cork University Hospital is a public hospital owned and managed by the Health Service Executive and serves a total population over 1.1 million.[13] Cork University Hospital

has arguably the busiest ED in Ireland with 69,982 presentations in 2019.[13, 14] The paediatric ED in CUH is audio-visually separated from the adult ED and treats all unscheduled presentations including medical and trauma.

The study used the electronic data from the Integrated Patient Management System (iPMS) in CUH. This is an administrative dataset. All paediatric attendances (children aged 0 to 15 years) to CUH ED from 1st July 2012 until 30th June 2018 were identified, allowing us to examine the ED attendances 3 years prior to and 3 years after the expansion of free GP care for under 6s. The data included ED attendees' age, date of arrival, ED arrival time, ED departure time, discharge destination, attendance type (new or return), and referral type. The referral type was categorised as GP referral, including out of hours GP referrals, and non-GP referrals. The triage information on reason for attendance or the treatment received is not captured reliably and therefore was not analysed; however, whether the ED attendance resulted in an inpatient admission, transfer to a different hospital or death was considered a proxy for severity of reason for attendance.

The study used the anonymised administrative data and had full approval from the Clinical Ethics Committee of the Cork Teaching Hospitals. Patients were not involved in this study.

Free GP care was expanded to all children aged under 6 years in July 2015. This age group (< 6 years) was used as the treatment group in the analysis. As CUH provides care for all children aged 0 to 15 years, children aged 6 – 15 years were chosen as the control group.

Two time periods were analysed:

- Time Period 1: from 1st July 2012 to 30th June 2015;
- Time Period 2: from 1st July 2015 to 30th June 2018.

To better understand the overall trend in the paediatric ED attendances in CUH over the 6-year period, a number of annual ED attendances was also analysed for each study group and for single year of age (SYOA). As the data were analysed over a 12-months or 3-years periods, there was no need to control for seasonal variation in ED attendances.

The statistical analyses were performed using the IBM SPSS Statistics 25. Categorical variables were described using number of cases and percentage (%). Two-sided χ^2 test was used evaluate the differences between the categorical variables. Post-hoc analyses were performed for SYOA. Bonferroni correction was applied for multiple comparisons if *P* was less than 0.05 in the initial χ^2 test.

RESULTS

Over the period of 6 years (July 1st 2012 – June 30th 2018), CUH ED was attended by 76,831 children aged 0 – 15 years. Table 1 summarises all paediatric attendances to CUH ED during the two study periods.

Table 1. Descriptive statistics of the iPMS data for children under 6 (0 – 5 years) and over 6 (6 – 15 years) who attended CUH ED during the study period (July 1st 2012 – June 30th 2018).

	Under 6s (0 - 5 years)			***Over 6s (6 - 15 years)***		
	July 2012 – June 2015	***July 2015 – June 2018***	***P-value[a]***	***July 2012 – June 2015***	***July 2015 – June 2018***	***P-value[a]***
Attendances, n (%)	19,199 (53.6)	22,934 (55.9)		16,620 (46.4)	18,078 (44.1)	
Referral Type, n (%)						
GP Referrals	10,148 (52.9)	14,028 (61.2)	**< 0.0001**	8,684 (52.3)	9,724 (53.8)	**0.004**
Non-GP Referrals[b]	9,051 (47.1)	8,906 (38.8)		7,936 (47.7)	8,354 (46.2)	
Type of Attendance (%)						
New	18,413 (95.9)	22,016 (96.0)	0.636	15,884 (95.6)	17,289 (95.6)	0.771
Return	786 (4.1)	918 (4.0)		736 (4.4)	789 (4.4)	
Day of Week (%)						
Sunday	2,635 (13.7)	3,025 (13.2)	0.109	2,065 (12.4)	2,172 (12.0)	0.244
Monday	2,940 (15.3)	3,647 (15.9)	0.097	2,707 (16.3)	2,908 (16.1)	0.610
Tuesday	2,707 (14.1)	3,292 (14.4)	0.456	2,481 (14.9)	2,710 (15.0)	0.807
Wednesday	2,745 (14.3)	3,279 (14.3)	0.999	2,421 (14.6)	2,812 (15.6)	0.010
Thursday	2,746 (14.3)	3,198 (13.9)	0.292	2.441 (14.7)	2,662 (14.7)	0.920
Friday	2,722 (14.2)	3,416 (14.9)	0.038	2,261 (13.6)	2,538 (14.0)	0.241
Saturday	2,704 (14.1)	3,077 (13.4)	0.047	2,244 (13.5)	2,276 (12.6)	0.012
Time (%)						
00:00-05:59	1,529 (8.0)	1,767 (7.7)	0.032	834 (5.0)	905 (5.0)	0.377
06:00-11:59	3,543 (18.5)	4,080 (17.8)	0.078	3,308 (19.9)	3,719 (20.6)	
12:00-17:59	7,440 (38.8)	9,197 (40.1)	**0.005**	6,427 (38.7)	6,999 (38.7)	
18:00-23:59	6,687 (34.8)	7,890 (34.4)	0.359	6,051 (36.4)	6,455 (35.7)	
Triage Category (%)						
Immediate/Resuscitation	156 (0.8)	179 (0.8)	0.712	72 (0.4)	72 (0.4)	0.613
Very Urgent/Emergency	4,766 (24.8)	7,159 (31.2)	**< 0.0001**	2,696 (16.2)	3,768 (20.8)	**< 0.0001**
Urgent	10,679 (55.6)	11,700 (51.0)	**< 0.0001**	9,166 (55.2)	9,562 (52.9)	**< 0.0001**
Standard/Less Urgent	2,798 (14.6)	3,401 (14.8)	0.460	3,861 (23.2)	4,027 (22.3)	0.034
Not Urgent	90 (0.5)	275 (1.2)	**< 0.0001**	146 (0.9)	402 (2.2)	**< 0.0001**
Not Triaged/Return	710 (3.7)	220 (1.0)	**< 0.0001**	679 (4.1)	247 (1.4)	**< 0.0001**
Discharge Dest. (%)						
Home	13,707 (71.4)	17,225 (75.1)	**< 0.0001**	12,491 (75.2)	13,799 (76.3)	0.011
Admitted	5,031 (26.2)	5,382 (23.5)	**< 0.0001**	3,673 (22.1)	3,938 (21.8)	0.476
Deceased	16 (0.1)	8 (0.0)	0.038	7 (0.0)	6 (0.0)	0.668
Self-Discharge	244 (1.3)	216 (0.9)	**0.001**	242 (1.5)	214 (1.2)	0.026
Other	196 (1.0)	97 (0.4)	**< 0.0001**	202 (1.2)	116 (0.6)	**< 0.0001**

IQR = interquartile range; min = minimum; max = maximum

[a] χ^2 test (2-sided); Bonferroni correction was used for multiple comparisons if *P* was less than 0.05 in the initial χ^2 test for tables larger than 2 x 2. The results that remained statistically significant after the Bonferroni correction are highlighted in bold.

[b] Non-GP referrals includes self-referral, not specified, referral within the system, and return ED patients.

There was a 14.5% increase in all paediatric attendances in Time Period 2 (n = 41,012) compared to Time Period 1 (n = 35,819). Higher attendances were observed in the under 6 years group compared to the 6 - 15 years group in both study periods, with increases in

attendances seen after July 2015 (19,199 vs 16,620 in the Time Period 1 and 22,934 vs 18,078 in the Time Period 2 respectively).

The proportions of children referred to CUH ED by GP were similar in both study groups in Time Period 1 (52.9% in the under 6 years group and 52.3% in the 6 – 15 years group) and significantly increased in Time Period 2 by 8.3% in the under 6 years group (61.2%, χ^2 test, $P < 0.0001$), and by 1.5% in the 6 – 15 years group (53.8%, χ^2 test, $P = 0.004$).

There was a significant increase in the proportions of children in both groups that were triaged as "Very Urgent/Emergency" (from 24.8% to 31.2% in under 6 years group, χ^2 test, $P < 0.0001$; from 16.2% to 20.8% in the 6 - 15 years group, χ^2 test, $P < 0.0001$) and "Non Urgent" (from 0.5% to 1.2% in the under 6 years group, χ^2 test, $P < 0.0001$; from 0.9% to 2.2% in the 6 – 15 years group, χ^2 test, $P < 0.0001$). At the same time a significant decrease was observed in the proportion of children in both groups that were triaged as "Urgent" (from 55.6% to 51% in the under 6 years group, χ^2 test, $P < 0.0001$; from 55.2% to 52.9% in the 6 – 15 years group, χ^2 test, $P < 0.0001$).

There was a significant increase in the proportion of children in the under 6 years group in Time Period 2 that attended CUH ED during the day hours (12:00 and 18:00) (from 7,440 (38.8%) in Time Period 1 to 9,197 (40.1%) in Time Period 2, χ^2 test, $P = 0.005$).

A significantly higher proportion of children in the under 6 years group was discharged home from ED in Time Period 2 compared to Time Period 1 (75.1% and 71.4% respectively, χ^2 test, $P < 0.0001$) and significantly lower proportion of children in the same age group was admitted to hospital in Time Period 2 compared to Time Period 1 (23.5% and 26.2% respectively, χ^2 test, $P < 0.0001$).

There was no difference in the proportion of children who attended CUH ED as a new or return patient during the two time periods in both study groups. Similarly, no statistically significant differences were observed in the proportions of children that attended on a particular day of the week between Time Period 1 and 2 for both study groups.

Figure 1 presents the number of CUH ED attendances by SYOA before and after the policy change regardless of the mode of referral. The number of CUH ED paediatric attendances was highest in younger children with an increase in ED attendances observed in children under the age of 10 years after the expansion of free GP care to under 6s. There was no change in the volume of presentations in older children.

Insert Figure 1 here

Figure 2 demonstrates the number of children in both study groups that attended CUH ED through GP and non-GP referrals annually during the two study periods. A sustained step increase in CUH ED attendances through GP referrals was observed after July 2015.

Insert Figure 2 here

The percentage of CUH ED attendances through a GP referral varied across all ages. There was a significant increase in GP referral rates in children aged under 6 years after free GP care for under 6s was introduced in July 2015. No significant increase was observed in GP referral rates in children aged 6 – 15 years by SYOA (see Figure 3 and Table 2).

Insert Figure 3 here

Table 2. Number and percentage of CUH ED attendances in different age groups that came via a GP referral: July 2012 –June 2015 and July 2015 – June 2018.

Age	GP Referrals, n (%)		p-value[a]
	July 2012-June 2015	July 2015-June 2018	
0-1	2221 (55.6)	3934 (66.3)	**<0.0001**
1-2	2254 (51.1)	3005 (58.9)	**<0.0001**
2-3	1835 (50.8)	2231 (59.2)	**<0.0001**
3-4	1515 (53.9)	1866 (59.5)	**<0.0001**
4-5	1252 (53.6)	1614 (60.4)	**<0.0001**
5-6	1072 (52.8)	1378 (59.4)	**<0.0001**
6-7	894 (55.3)	1193 (57.4)	0.208
7-8	878 (56.9)	1115 (58.2)	0.434
8-9	865 (56.0)	1049 (55.6)	0.786
9-10	966 (57.5)	1099 (56.8)	0.686
10-11	839 (52.9)	857 (54.3)	0.427
11-12	824 (52.6)	849 (53.3)	0.675
12-13	772 (51.4)	856 (53.3)	0.297
13-14	850 (49.8)	856 (51.0)	0.489
14-15	858 (47.0)	927 (51.1)	0.012
15-16	938 (45.8)	917 (46.4)	0.733

[a] χ^2 test (2-sided). Bonferroni correction was applied for multiple comparisons. The results that remained significant are highlighted in bold.

Despite the significant increase in CUH ED attendances via a GP referral in the under 6 years group post free GP care for under 6s was introduced, a decrease in hospital admission rates across all ages in this study group was observed after July 2015 (see Figure 4 and Table 3). This reached statistical significance in children aged from 1 to 2 years (decrease from 27.6% in Time Period 1 to 23.0% in Time Period 2, χ^2 test, $P = 0.0001$) and 4 to 5 years (decrease from 23.7% in Time Period 1 to 16.4% in Time Period 2, χ^2 test, $P < 0.0001$).

Insert Figure 4 here

Table 3. Percentage of patients who attended CUH ED via a GP referral and were either admitted to ward, transferred to a different hospital or deceased across all age groups: July 2012 – June 2015 and July 2015 – June 2018.

Age	***Admitted/Transferred/Deceased, n (%) of all Attendances through GP referrals***		***P-value[a]***
	July 2012-June 2015	***July 2015-June 2018***	
0-1	837 (37.7)	1339 (34.0)	0.004
1-2	622 (27.6)	692 (23.0)	***0.0001***
2-3	408 (22.2)	410 (18.4)	0.002
3-4	304 (20.1)	337 (18.1)	0.127
4-5	297 (23.7)	265 (16.4)	***<0.0001***
5-6	251 (23.4)	278 (20.2)	0.053
6-7	195 (21.8)	263 (22.0)	0.947
7-8	191 (21.8)	232 (20.8)	0.566
8-9	197 (22.8)	193 (18.4)	0.018
9-10	194 (20.1)	233 (21.2)	0.531
10-11	192 (22.9)	191 (22.3)	0.769
11-12	200 (24.3)	206 (24.3)	0.997
12-13	174 (22.5)	186 (21.7)	0.694
13-14	171 (20.1)	198 (23.2)	0.105
14-15	207 (24.2)	209 (22.6)	0.396
15-16	254 (27.1)	207 (22.5)	0.020

[a] χ^2 test (2-sided). Bonferroni correction was applied for multiple comparisons. The results that remain significant are highlighted in bold.

Insert Table 3 here

DISCUSSION

This study has shown that following the expansion of free GP care to children under 6 years in Ireland, there was an overall increase in CUH ED attendances with a significant increase in attendances via a GP referral in children under 6 years. GP referral rates remained higher in the under 6 years group during the 3-year period post-expansion. Despite more than an 8% increase in the GP referral rates in the under 6 years group, there was a noticeable decrease in hospital admission rates in the same age group.

Previous quasi-experimental research study on the same age group in Ireland also reported an increase in the rate of GP referral to EDs in under 6s following the introduction of free GP care for under 6s.[15] The percentage increase reported in this study, however, was smaller

than in our study (2% vs 8.3% respectively). This might be explained by the fact that the data analysed in this study were from 28 different Irish hospitals with different levels of care and were not reported for individual hospitals. Also, the observation periods in this study were much shorter than in our study and included only 6 months before and 12 months after the expansion of free GP care to under 6s, with the relevant 6-months periods compared. A much higher increase in GP referral rates in the under 6 years group following the policy change in our study can be explained by the fact that CUH is a major tertiary hospital with an extensive catchment area. Moreover, the results of our study are based on longer observation periods with overall and annual attendances compared 3 years before and 3 years after free GP care for under 6s was introduced.

Emergency department crowding is a global phenomenon with many contributing factors including inadequate access to primary care and specialists, inappropriate patient referral and the general public expectations of health care delivery.[16] A growing rate of ED attendances, including paediatric presentations, that contribute to overcrowding of the emergency services has been reported in a number of countries. An Australian study based in a tertiary paediatric referral hospital with 32 000 annual attendances reported an 11.3% increase in paediatric presentations from 2012/2013 to 2013/2014.[17] The US National Health Interview Survey found that 25% of children younger than 5 years and 18% of those aged 6 to 17 years had been seen in ED at least once in 2018, compared to 23% and 15% respectively in 2017.[18] The over utilisation of the paediatric ED services has been reported in the Lombardy Region of Italy with 26.8% of all children in the region attending the ED at least once during 2012.[19] While the overuse of the paediatric ED seems a universal problem, differences in the structure of healthcare between countries have varying impacts. For example, the same study from Lombardy found that only 2% of all children in the study were referred to ED by their primary

care physician, whereas 89% presented on parental request with no referral.[19] Different structure of the primary care in Italy where family paediatricians provide primary health care to all children under the age of 6 years and optionally, depending on parental preferences, up to the age of 14 years, might partially explain the low referral rate to ED by primary care physicians. Whereas the high self-referral rate could be explained by the fact that in Italy all paediatric ED attendances under the age of 14 years are free of charge regardless of the mode of presentation.[19]

It is obvious that the impact of free GP care expansion on paediatric ED use is multifactorial and clearly dependent on the existing health care system. In our study, a significant increase in GP referrals to ED for children aged under 6 years is important for several reasons. Firstly, it might be reflective of increased pressure placed on already strained primary care system by increased demand and insufficient number of GPs to meet this demand.[10] Secondly, increased paediatric ED attendances are likely to contribute to ED overcrowding. When free GP care was expanded to children under 6 years of age in Ireland, no structural reorganisation or financial support was introduced for the upstream services, including ED. Secondly, despite significant increases in GP referrals of children under 6 years to CUH ED, there was a significant drop in hospital admission rates in this category of patients, the largest reaching more than 7% in children aged 4 to 5 years. This suggests that some of these ED presentations may have been for minor conditions and could have been potentially avoided. Some may have been driven by a desire by parents and GPs to have a second opinion to resolve diagnostic uncertainty for conditions that ultimately transpired to be self-limiting.

Based on our findings several conclusions can be drawn. As the introduction of free GP care for children under 6s increases pressure on paediatric ED services, there is a strong need for

investment in paediatric emergency medicine in Ireland in order to meet the increasing demands of these increasing ED presentation rates. A short stay paediatric unit, for example, has been shown to improve patient care in a cost-effective way and it could be a useful addition to the existing ED services.[20] Supplying the ED with the appropriate support structures and adequate staffing must also be considered.

Better support for the primary care providers is also important. Introduction of a capitation payment system in Norway led to an increased GP referral rates to private hospitals and clinics, possibly because there was no financial incentive to undertake the procedures in the GP clinic. [21] Some of the possible options, therefore would be to consider a blended model whereby GPs are remunerated for simple procedures when appropriate, for example for managing minor injuries. A further recommendation could also include widening the GPs access to simple diagnostics, in particular x-ray. The introduction of telemedicine consultations with general paediatricians and paediatric specialists for GPs,[22] as well as establishing new acute paediatric assessment services such as rapid access clinics and paediatric assessment units,[23, 24] should also be explored.

Strengths and limitations

This is the first Irish study that has evaluated the characteristics of paediatric ED attendances of the major tertiary referral centre 3 years before and 3 years after the expansion of free GP care to children aged under 6 years. The observations collected over a 6-years period allow to avoid the seasonal variation in paediatric attendances bias.

Several limitations are recognised in this study. First, due to the large dataset and inconsistent data entry we were unable to analyse the reason for CUH ED attendance by patients. This information would have been useful to better understand the spectrum of reasons for GP

referrals and therefore, help to design potential solutions for the primary care support. Secondly, our findings might not be applicable to other Irish hospitals with smaller catchment areas and different ED structures.

CONCLUSION

Our study shows that there was a significant increase in paediatric GP referrals to CUH ED following the expansion of free GP care to children under 6 years. At the same time the hospital admission rates in the same category of patients significantly decreased suggesting that many of these CUH ED visits could have been potentially avoided should there have been sufficient support available for the primary care providers. This increased use of the paediatric ED services that this study showed might be reflective of the struggle of the primary care to meet the increased healthcare system demand and might have serious implications for the quality and safety of patients' hospital care. It is of vital importance to develop strategies to support both primary and secondary health care before the next phase of Universal GP Care is rolled out.

Contributors All the authors contributed equally to the study. IK and CD were involved in designing the study and planning the data analysis. IK undertook the statistical analysis and wrote the first draft of the manuscript. ES was involved in data collection and management. RO'B, CB and CD contributed in writing the manuscript. CD supervised the study. All authors contributed to and have approved the final manuscript.

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Competing interests None declared.

Patient consent Not required.

Figures' legends:

Figure 1. Number of CUH ED attendances by age, regardless of the mode of referral: July 1st 2012 – June 30th 2015 and July 1st 2015 – June 30th 2018. 0 – 15 years.

Figure 1. The number of CUH ED attendances through GP and non-GP referral in the under 6 years and 6 to 15 years groups each year from July 1st, 2012 to June 30th, 2018.

Figure 3. Percentage of CUH ED attendances through GP referral in different age groups: July 2012 – June 2015 and July 2015 – June 2018.

Figure 4. Percentage of patients who were either admitted to ward, transferred to a different hospital, or deceased out of all CUH ED attendances that came through a GP referral: July 2012 – June 2015 and July 2015 – June 2018.

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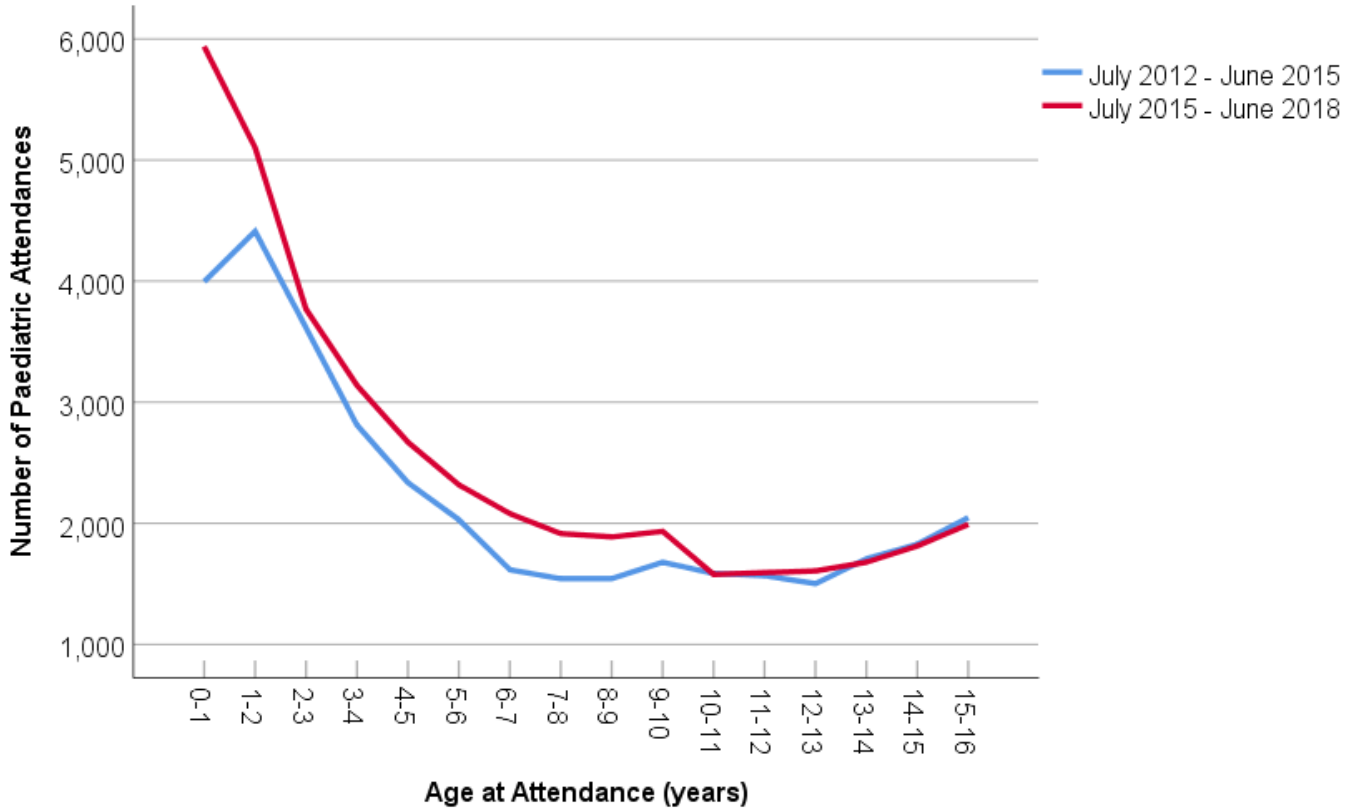
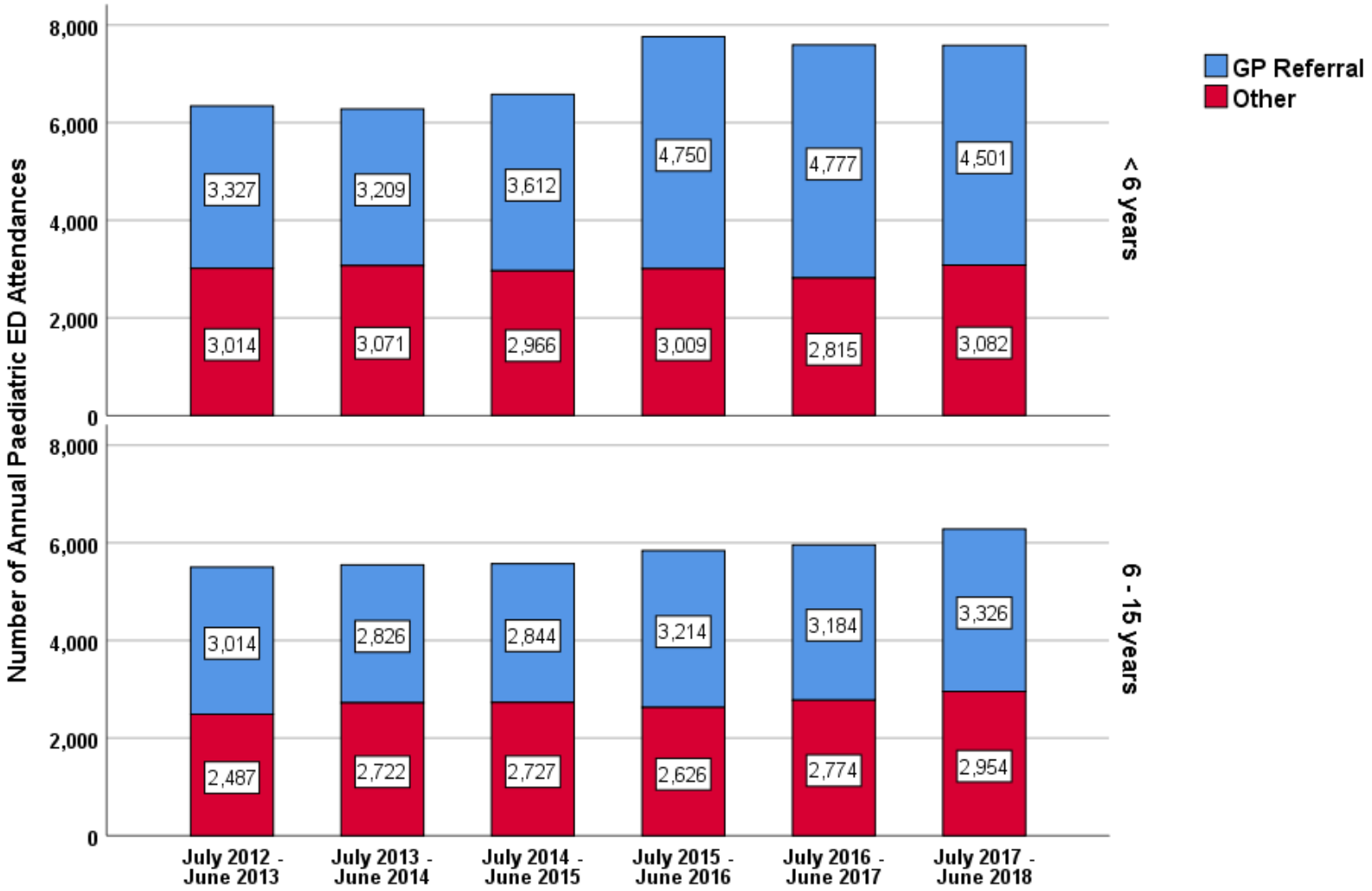


Figure 1. Number of CUH ED attendances by age, regardless of the mode of referral: July 1st 2012 – June 30th 2015 and July 1st 2015 – June 30th 2018. 0 – 15 years.



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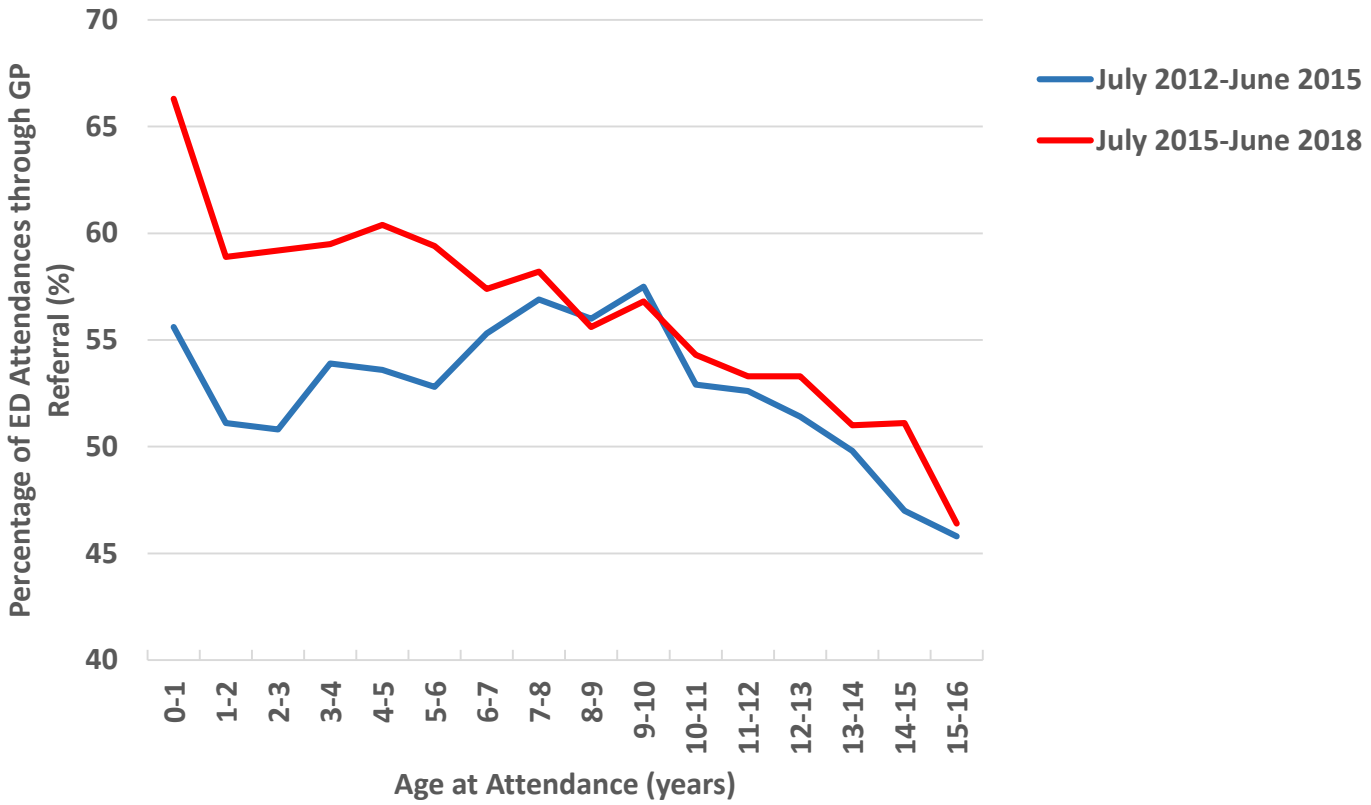

Figure 3. Percentage of CUH ED attendances through GP referral in different age groups: July 2012 – June 2015 and July 2015 – June 2018.

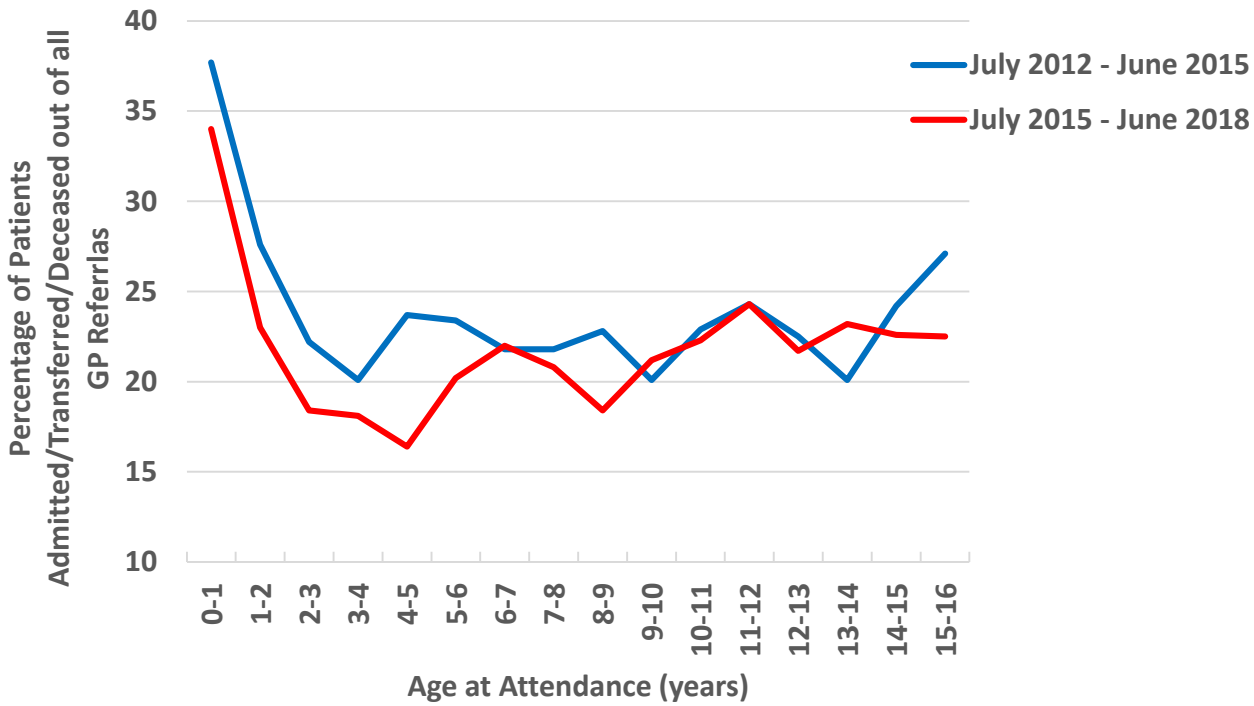

Figure 4. Percentage of patients who were either admitted to ward, transferred to a different hospital, or deceased out of all CUH ED attendances that came through a GP referral: July 2012 – June 2015 and July 2015 – June 2018.

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Paediatric Attendances of the Emergency Department in a Major Irish Tertiary Referral Centre Before and After Expansion of Free GP Care to Children Under 6: A Retrospective Observational Study

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ABSTRACT

Objectives: To examine the characteristics of paediatric attendances to the Emergency Department (ED) in Cork University Hospital (CUH) before and after the expansion of free GP care to children under the age of 6 years.

Design: This is a retrospective observational study that used a large administrative dataset.

Setting: The study was conducted in major Irish tertiary referral centre that serves a total population of over 1.1 million. It is a public hospital, owned and managed by the Health Service Executive.

Participants: Children aged 0-15 years who attended CUH ED during the study period of 6 years (2012 – 2018) were included in this study (n = 76,831).

Interventions: Free GP care was expanded to all children aged 0-5 years in July 2015.

Main outcome measures: Paediatric attendances to CUH ED were examined before (Time Period 1: July 2012 - June 2015) and after (Time Period 2: July 2015 - June 2018) the expansion of free GP care to children under 6. Changes in GP referral rates and inpatient hospital admissions were investigated.

Results: Paediatric presentations to CUH ED increased from 35,819 during the Time Period 1 to 41,012 during the Time Period 2 (14.5%). The proportion of the CUH ED attendances through GP referrals by children under 6s increased by over 8% in the Time Period 2 (from 10,148 to 14,028). Although the number of all children who attended CUH ED and were admitted to hospital increased in Time Period 2 (from 8,704 to 9,320); the proportion of children in the 0-5 years group who attended the CUH ED through GP referral and were subsequently admitted to hospital, decreased by over 3%.

Conclusion: The expansion of free GP care has upstream health service utilisation implications, such as increased attendances at ED, and should be considered and costed by policy-makers.

What is known about the subject

- A growing rate of Emergency Department (ED) attendances, including paediatric presentations, that contribute to overcrowding of the emergency services is a global phenomenon.
- When medical care is free of charge, children and adolescents increase the number of doctor visits.
- A 25% increase in GP attendances by children aged under 6 years was observed in Ireland following the expansion of free GP care to this age group.

What this study adds

- A significant sustained increase in paediatric GP referrals to the ED of a major Irish tertiary referral centre was observed following the expansion of free GP care to children under 6 years.
- Despite the increase in paediatric GP referrals to Cork University Hospital (CUH) ED, the proportion of children under the age of 6 that were admitted to hospital decreased.
- The expansion of free GP care has upstream health service utilisation implications and must be considered by policy-makers.

INTRODUCTION

There is sufficient evidence that health in childhood has strong long-term impacts on socioeconomic status and adulthood health.[1-4] Making primary care more accessible should encourage children to seek medical attention when needed and hypothetically, improve the general population health long-term.

Currently, the majority of the Irish population pay out-of-pocket fees for their General Practitioner (GP) visits and these payments for primary care are the highest among the European Union countries.[5] In 2011 the Irish Government made a commitment to introduce Universal GP Care which guaranteed free GP care for all.[6] The roll out of free GP care for children under 6 years was the first step taken by the Government towards that goal.

On July 1st 2015 all children aged under 6 years became entitled to free GP care in Ireland. The introduction of the free GP care for children aged under 6 years was aligned with the national policy as described in the Future Health Strategic Framework and aimed to ensure effective, safe and high-quality health services for young children.[7]

GP referral is the preferred mode of accessing hospital services for acute presentations in Ireland. However, direct access to ED (by self-referral) is also available though this is discouraged by the charge of a fee of €100 if attending without a GP referral. This fee is also levied in respect of children attending ED.

It has been shown that when medical care is free of charge, children and adolescents increase the number of doctor visits by 5-10%.[3] A USA-based study that estimated the average association between outpatient and inpatient care, showed that expanded use of primary care, through insurance policy changes and improved access to primary care, was associated

with a greater number of hospital presentations and an increase in inpatient spending. It was noted that this was particularly the case for the conditions for which the decision to admit to hospital was potentially more at the discretion of the primary care physician. Thus, increased access to primary care does not always result in savings in secondary care as is often assumed it will.[8]

By December 2016, the number of children under the age of 6 years who were eligible for free GP care in Ireland doubled compared to December 2014.[9] At the same time, a 25% increase in GP attendances in this age group was reported.[10] There are clear indications that the Irish primary care system provided by GPs is already under pressure and may struggle to meet demand in the near future.[10-12] This might have implications for upstream health services, especially Emergency Departments (ED), which often serve as substitutes for primary care, though not designed for this type of work.

As the next phase of rolling out of Universal GP care was been announced on January 5th, 2020 by the Irish Government, with expansion of GP care without fees to 6 and 7 year-olds this year and further phased extension to all children aged under 13, it is important that all potential implications are considered.

This study aimed to investigate the impact of free GP care to children under the age of 6 years on the characteristics of paediatric attendances at Cork University Hospital (CUH) ED.

METHODS

This research was conducted in a major Irish tertiary referral centre and university training hospital. Cork University Hospital is a public hospital owned and managed by the Health Service Executive and serves a total population over 1.1 million.[13] Cork University Hospital

has arguably the busiest ED in Ireland with 69,982 presentations in 2019.[13, 14] The paediatric ED in CUH is audio-visually separated from the adult ED and treats all unscheduled presentations including medical and trauma.

The study used the electronic data from the Integrated Patient Management System (iPMS) in CUH. This is an administrative dataset. All paediatric attendances (children aged 0-15 years) to CUH ED from 1st July 2012 until 30th June 2018 were identified, allowing us to examine the ED attendances 3 years prior to and 3 years after the expansion of free GP care for under 6s. The data included ED attendees' age, date of arrival, ED arrival time, ED departure time, discharge destination, attendance type (new or return), and referral type. The referral type was categorised as GP referral, including out of hours GP referrals, and non-GP referrals. The triage information on reason for attendance or the treatment received is not captured reliably and therefore was not analysed; however, whether the ED attendance resulted in an inpatient admission, transfer to a different hospital or death was considered a proxy for severity of reason for attendance.

The study used the anonymised administrative data and had full approval from the Clinical Ethics Committee of the Cork Teaching Hospitals. Patients were not involved in this study.

Free GP care was expanded to all children aged under 6 years in July 2015. This age group (0-5 years) was used as the treatment group in the analysis. As CUH provides care for all children aged 0-15 years, children aged 6-15 years were chosen as the control group.

Two time periods were analysed:

- Time Period 1: from 1st July 2012 to 30th June 2015;
- Time Period 2: from 1st July 2015 to 30th June 2018.

To better understand the overall trend in the paediatric ED attendances in CUH over the 6-year period, a number of annual ED attendances was also analysed for each study group and for single year of age (SYOA).

We conducted logistic regression analysis stratified by time periods (Time Period 1 and 2) to assess whether the expansion of free GP care to children under 6 years affected the use of ED services, with younger children (0-5 years) being the exposed group compared to older children (6-15 years). The outcome of interest was a GP referral, which represented whether the ED attendance occurred following a GP referral or not. We conducted three models to investigate the relationship between children's age and year of attendance on the probability of ED attendance being a GP referral, using different interaction terms between these variables.

In the first model, we introduced an interaction term between age (0-5 or 6-15 years) and year of attendance (six categories, from July 2012 until June 2018). In the second model, we used an interaction term between year of attendance (two categories: (July 2012-June 2015) or (July 2015-June 2018)) and age in years (as categorical variable). We further explored the effect of the introduction of free GP service to children under 6 years on CUH ED paediatric attendances by using an interaction term between age (as continuous variable) and attendance year (from July 2012 to June 2018) [model 3]. We used interaction to allow the slope of independent variables to vary based on the main exposures (year of attendance or children's age). The predictive marginal effects of the interaction terms were plotted to better visualise how much the predicted probability of being referred by a GP changes with the change in age and year of attendance. [15] All models were additionally adjusted for presentation day, time of attendance and discharge destination.

We also used cubic splines to model the shape of the association between year of attendance and the outcome, using the postrcspline package. [16] The day of attendance was converted into months and treated as continuous variable (from July 2012 until June 2018). Spline coefficients cannot be interpreted directly, therefore, the model was displayed graphically, showing the predicted adjusted probability of the ED attendance being a GP referral. This model was adjusted for age, presentation day, attendance time and discharge destination. We further assessed the discharge destination in children that came through a GP referral using predictive margins plot to illustrate the results. This analysis was restricted to patients with a GP referral only, with discharge destination as an outcome (admitted/transferred/deceased or discharged home). This model was adjusted for presentation day and time of attendance with an interaction term between children's age and attendance year (July 2012-June 2015 or July 2015-June 2018). Data analyses were performed using Stata version 16.1 (StataCorp, College Station, TX, U.S.A.) and a significance level of $P < 0.05$ was used.

RESULTS

Over the period of 6 years (July 1st 2012 – June 30th 2018), CUH ED was attended by 76,831 children aged 0-15 years; 42,584 (53.3%) of them came through a GP referral. There was a 14.5% increase in all paediatric attendances in Time Period 2 (n = 41,012) compared to Time Period 1 (n = 35,819). The attendances were higher in the 0-5 years group in both study periods compared to the 6-15 years group (19,199 vs 16,620 in the Time Period 1 and 22,934 vs 18,078 in the Time Period 2 respectively). Table 1 summarises all paediatric attendances to CUH ED during the two study periods. Figure 1 presents the number of all paediatric CUH ED attendances by SYOA before (July 2012 – June 2015) and after (July 2015 – June 2018) the

policy change regardless of the mode of referral. The number of CUH ED paediatric attendances was highest in younger children with an increase in ED attendances observed in children under the age of 10 years after the expansion of free GP care to under 6s. There was no change in the volume of presentations in older children.

Table 1. Descriptive statistics of the iPMS data for children under 6 (0 – 5 years) and over 6 (6 – 15 years) who attended CUH ED during the study period (July 1st 2012 – June 30th 2018).

	Under 6s (0-5 years)		***Over 6s (6 – 15 years)***	
	July 2012 – June 2015	***July 2015 – June 2018***	***July 2012 – June 2015***	***July 2015 – June 2018***
Attendances, n (%)	19,199 (53.6)	22,934 (55.9)	16,620 (46.4)	18,078 (44.1)
Referral Type, n (%)				
GP Referrals	10,148 (52.9)	14,028 (61.2)	8,684 (52.3)	9,724 (53.8)
Non-GP Referrals	9,051 (47.1)	8,906 (38.8)	7,936 (47.7)	8,354 (46.2)
Type of Attendance (%)				
New	18,413 (95.9)	22,016 (96.0)	15,884 (95.6)	17,289 (95.6)
Return	786 (4.1)	918 (4.0)	736 (4.4)	789 (4.4)
Triage Category (%)				
Immediate/Resuscitation	156 (0.8)	179 (0.8)	72 (0.4)	72 (0.4)
Very Urgent/Emergency	4,766 (24.8)	7,159 (31.2)	2,696 (16.2)	3,768 (20.8)
Urgent	10,679 (55.6)	11,700 (51.0)	9,166 (55.2)	9,562 (52.9)
Standard/Less Urgent	2,798 (14.6)	3,401 (14.8)	3,861 (23.2)	4,027 (22.3)
Not Urgent	90 (0.5)	275 (1.2)	146 (0.9)	402 (2.2)
Not Triaged/Return	710 (3.7)	220 (1.0)	679 (4.1)	247 (1.4)
Discharge Dest. (%)				
Home	13,707 (71.4)	17,225 (75.1)	12,491 (75.2)	13,799 (76.3)
Admitted	5,031 (26.2)	5,382 (23.5)	3,673 (22.1)	3,938 (21.8)
Deceased	16 (0.1)	8 (0.0)	7 (0.0)	6 (0.0)
Self-Discharge	244 (1.3)	216 (0.9)	242 (1.5)	214 (1.2)
Other	196 (1.0)	97 (0.4)	202 (1.2)	116 (0.6)

Insert Figure 1 Here

There was a clear increase in the proportions of children in both groups that were triaged as "Very Urgent/Emergency" (from 24.8% to 31.2% in the 0-5 years group and from 16.2% to 20.8% in the 6-15 years group) and "Non Urgent" (from 0.5% to 1.2% in the 0-5 years group and from 0.9% to 2.2% in the 6-15 years group). At the same time a decrease was observed in the proportion of children in both groups that were triaged as "Urgent" (from 55.6% to 51% in the 0-5 years group and from 55.2% to 52.9% in the 6-15 years group).

There was no difference in the proportion of children who attended CUH ED as a new or return patient during the two time periods in both study groups. Similarly, no statistically significant differences were observed in the proportions of children that attended on a particular day of the week between Time Period 1 and 2 for both study groups (Supplementary table 1).

More children attended CUH ED and were discharged home in both age groups in Time Period 2 compared to Time Period 1 (17,225 (75.1%) vs 13,707 (71.4%) in the 0-5 years group and 13,799 (76.3%) vs 12,491 (75.2%) in the 6-15 years group). There was an increase in the actual number, but a decrease in the proportion of children subsequently admitted to hospital in both age groups in Time Period 2 compared to Time Period 1 (5,382 (23.5%) vs 5,031 (26.2%) in the 0-5 years group and 3,938 (21.8%) vs 3,673 (22.1%) in the 6-15 years group).

GP referral rates were similar in both groups in Time Period 1 (52.9% in the 0-5 years group and 52.3% in the 6-15 years group); however, there was a clear increase in GP referral rates in the 0-5 years group in Time Period 2 with no similar increase in the 6-15 years group (61.2% in the 0-5 year group and 53.8% in the 6-15 years group). Figure 2 demonstrates the number of annual CUH ED attendances via a GP and non-GP referral between July 2012 and June 2018 for children aged 0-5 years (Panel A) and 6-15 years (Panel B). This figure clearly shows that the number of CUH ED attendances through a GP referral in children aged 0-5 years increased after July 2015 with no similar increase observed in the older group (6-15 years).

Insert Figure 2 (Panel A & B) Here

The results from the adjusted logistic regression model, with time as a spline explanatory variable, showed an increased probability of CUH ED attendances by children in the 0-5 years group with a GP referral after the expansion of free GP care to under 6s in July 2015 (Figure 3-B). Whereas approximately the same pattern before and after the policy change was observed for ED attendances through a GP referral by children aged 6-15 years (Figure 3-C).

Insert Figure 3 (A-C) Here

The results from the stratified analysis suggested a similar patterns of CUH ED attendances being GP referral in both younger and older children in the Time Period 1 (July 2012-June 2015), as crude and adjusted estimates did not reach a significant level (Table 2). However, in the Time Period 2 (July 2015-June 2018) younger children (0-5 years) were more likely to attend CUH ED through a GP referral [adjusted odds ratio=1.39 (95% CI, 1.33, 1.44)] compared to older children (6-15 years) (Figure 4).

Table 2. Logistic regression of ED attendances being a GP referral stratified by year of attendance (July 2012 – June2015 and July 2015 – June 2018).

	Crude Odds ratio [95%CI]	Adjusted odds ratio [95%CI]*
Year at attendance (July 2012 - June 2015)		
0-5 years	1.02 [0.98, 1.07]	1.03 [0.99, 1.08]
6-15 years	Reference	Reference
Year at attendance (July 2015 - June 2018)		
0-5 years	1.35 [1.30, 1.41]	**1.39 [1.33, 1.44]**
6-15 years	Reference	Reference

*Adjusted for presentation day, attendance time and discharge destination

Insert Figure 4 Here

When the analyses were extended by interacting SYOA and year of attendance, the significant increase in CUH ED attendances was seen in all ages from 0 to 5 years with no significant increase observed in children from 6 to 15 years. Results from logistic regression analysis with interaction terms between SYOA and year of attendance show that after July 2015 younger children (0-5 years) were more likely to attend CUH ED through a GP referral (Figures 5 & 6).

Insert Figures 5 & 6 Here

Despite the significant increase in CUH ED attendances via a GP referral in the 0-5 years group in Time Period 2 and overall increase in the number of children in both age groups that came through a GP referral and were subsequently admitted to hospital (from 2,719 to 3,321 in 0-5 years group and from 1,975 to 2,118 in 6-15 years group), a decrease in hospital admission rates across younger ages in this study group was observed after July 2015. Figure 7 demonstrates the predictive margins with 95% CIs of the probability of ED attendance by children (0-15 years), that came through a GP referral, resulting in a hospital admission across SYOA before and after the expansion of free GP care to under 6s.

Insert Figure 7 Here

DISCUSSION

This study has shown that following the expansion of free GP care to children under 6 years in Ireland, there was an overall increase in CUH ED attendances with a significant increase in attendances via a GP referral in children under 6 years. GP referral rates remained higher in the 0-5 years group during the 3-year period post-expansion. The number of all children who attended CUH ED and were subsequently admitted to hospital also increased (from 8,704 in

Time Period 1 to 9,320 in Time Period 2). However, despite more than an 8% increase in the GP referral rates in the 0-5 years group after the expansion of free GP care to under 6s, the hospital admission rates in this category of children decreased by more than 3%.

Previous quasi-experimental research study on the same age group in Ireland also reported an increase in the rate of GP referral to EDs in under 6s following the introduction of free GP care for under 6s.[17] The percentage increase reported in this study, however, was smaller than in our study (2% vs 8.3% respectively). This might be explained by the fact that the data analysed in this study were from 28 different Irish hospitals with different levels of care and were not reported for individual hospitals. Also, the observation periods in this study were much shorter than in our study and included only 6 months before and 12 months after the expansion of free GP care to under 6s, with the relevant 6-months periods compared. A much higher increase in GP referral rates in the under 6 years group following the policy change in our study can be explained by the fact that CUH is a major tertiary hospital with an extensive catchment area. Moreover, the results of our study are based on longer observation periods with overall and annual attendances compared 3 years before and 3 years after free GP care for under 6s was introduced.

Emergency department crowding is a global phenomenon with many contributing factors including inadequate access to primary care and specialists, inappropriate patient referral and the general public expectations of health care delivery.[18] A growing rate of ED attendances, including paediatric presentations, that contribute to overcrowding of the emergency services has been reported in a number of countries.[19-21] While the overuse of the paediatric ED seems a universal problem, differences in the structure of healthcare between countries have varying impacts. For example, the study from Lombardy found that only 2% of

all children in the study were referred to ED by their primary care physician, whereas 89% presented on parental request with no referral.[21] Different structure of the primary care in Italy where family paediatricians provide primary health care to all children under the age of 6 years and optionally, depending on parental preferences, up to the age of 14 years, might partially explain the low referral rate to ED by primary care physicians. Whereas the high self-referral rate could be explained by the fact that in Italy all paediatric ED attendances under the age of 14 years are free of charge regardless of the mode of presentation.[21]

It is obvious that the impact of free GP care expansion on paediatric ED use is multifactorial and clearly dependent on the existing health care system. In our study, a significant increase in GP referrals to ED for children aged 0-5 years is important for several reasons. Firstly, it might be reflective of increased pressure placed on already strained primary care system by increased demand and insufficient number of GPs to meet this demand.[10] Secondly, increased paediatric ED attendances are likely to contribute to ED overcrowding. When free GP care was expanded to children under 6 years of age in Ireland, no structural reorganisation or financial support was introduced for the upstream services, including ED. Secondly, despite significant increases in GP referrals of children under 6 years to CUH ED, there was a significant drop in hospital admission rates in this category of patients, the largest reaching more than 7% in children aged 4 to 5 years. This might suggest that some of these ED presentations may have been for ambulatory care sensitive conditions or driven by a desire by parents and GPs to have a second opinion to resolve diagnostic uncertainty for conditions that ultimately transpired to be self-limiting.

Based on our findings several conclusions can be drawn. As the introduction of free GP care for children under 6s increases pressure on paediatric ED services, there is a strong need for

investment in paediatric emergency medicine in Ireland in order to meet the increasing demands of these increasing ED presentation rates. A short stay paediatric unit, for example, has been shown to improve patient care in a cost-effective way and it could be a useful addition to the existing ED services.[22] Supplying the ED with the appropriate support structures and adequate staffing must also be considered.

Better support for the primary care providers is also important. Introduction of a capitation payment system in Norway led to an increased GP referral rates to private hospitals and clinics, possibly because there was no financial incentive to undertake the procedures in the GP clinic. [23] Some of the possible options, therefore would be to consider a blended model whereby GPs are remunerated for simple procedures when appropriate, for example for managing minor injuries. A further recommendation could also include widening the GPs access to simple diagnostics, in particular x-ray. The introduction of telemedicine consultations with general paediatricians and paediatric specialists for GPs,[24] as well as establishing new acute paediatric assessment services such as rapid access clinics and paediatric assessment units,[25, 26] should also be explored.

Strengths and limitations

This study has evaluated the paediatric ED attendances of the major tertiary referral centre 3 years before and 3 years after the expansion of free GP care to children aged under 6 years. The observations collected over a 6-years period allow to avoid the seasonal variation in paediatric attendances bias.

Several limitations are recognised in this study. First, due to the large dataset and inconsistent data entry we were unable to analyse the reason for CUH ED attendance by patients. This information would have been useful to better understand the spectrum of reasons for GP

referrals and therefore, help to design potential solutions for the primary care support. Secondly, our findings might not be applicable to other Irish hospitals with smaller catchment areas and different ED structures.

CONCLUSION

Our study shows that there was a significant increase in paediatric GP referrals to CUH ED following the expansion of free GP care to children under 6 years. This increased use of the paediatric ED services might be reflective of the struggle of the primary care to meet the increased healthcare system demand and might have serious implications for the quality and safety of patients' hospital care. It is of vital importance to develop strategies to support both primary and secondary health care before the next phase of Universal GP Care is rolled out.

Contributors All the authors contributed equally to the study. IK and CD were involved in designing the study and planning the data analysis. SA and IK undertook the statistical analysis. IK wrote the first draft of the manuscript. ES was involved in data collection and management. RO'B, CB and CD contributed in writing the manuscript. CD supervised the study. All authors contributed to and have approved the final manuscript.

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Competing interests None declared.

Patient consent Not required.

Figures' legends:

Figure 1. Number of all CUH ED paediatric attendances (0 – 15 years) by age: July 2012 – June 2015 and July 2015 – June 2018.

Figure 2. Number of annual CUH ED paediatric attendances through GP and non-GP referrals in children 0-5 (Panel A) and 6-15 (Panel B) years of age: July 2012 – June 2018.

Figure 1. Spline plots of the relationship between ED attendance being a GP referral and time of attendance (time as spline explanatory variable). The model was adjusted for age, discharge destination, presentation day and attendance time. A) included all children (0-15 years); B) restricted to children aged 0-5 years; C) restricted to children aged 6-15 years.

Figure 4. Predictive margins with 95% CIs of the probability of ED attendance being a GP referral with an interaction term between attendance period and age group (0-5 and 6-15 years). The model was adjusted for discharge destination, presentation day and time of attendance.

Figure 5. Predictive margins with 95%CIs of the probability of ED attendance being through a GP referral with an interaction term between SYOA (categorical) and attendance period (July 2012 – June 2015 and July 2015 –June 2018). The model was adjusted for discharge destination, time of attendance and presentation date.

Figure 6. Predictive margins with 95% CIs of the probability of ED attendance by children (0-15 years) being a GP referral across single year of age: July 2012 – June 2018. This model included an interaction term between SYOA (continuous) and year of attendance, and was adjusted for discharge destination, presentation day and time of attendance.

Figure 7. Predictive margins with 95% CIs of the probability of ED attendance by children (0-15 years), that came through a GP referral, resulting in a hospital admission across single year of age: July 2012 – June 2015 and July 2015 – June 2018. This analysis was restricted to patients with a GP referral only (n = 42,584). This model included an interaction term between children's age and attendance period (July 2012 – June 2015 and July 2015 – June 2018), and was adjusted for presentation day and time of attendance.

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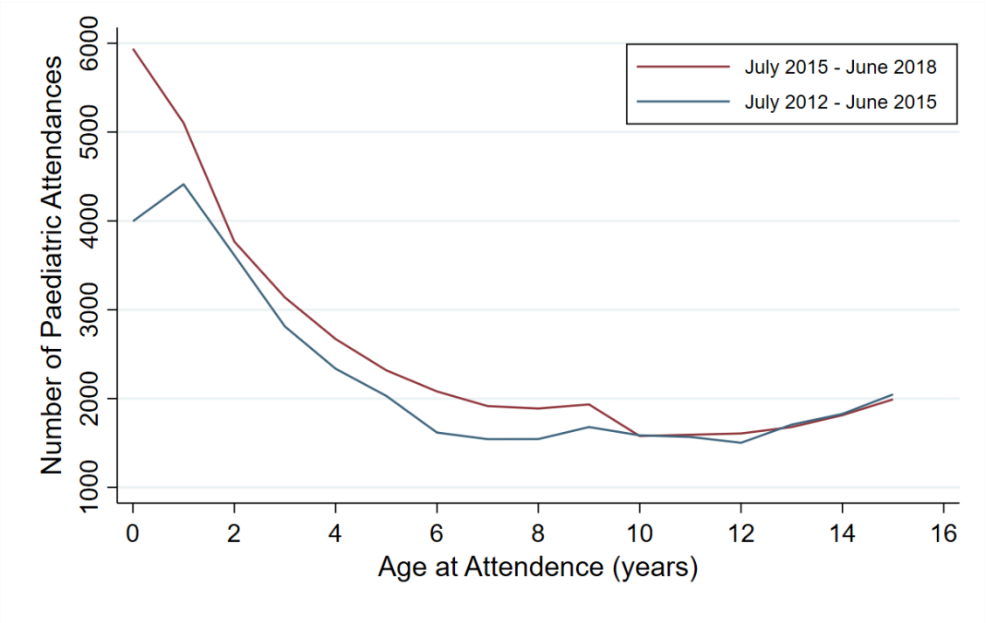
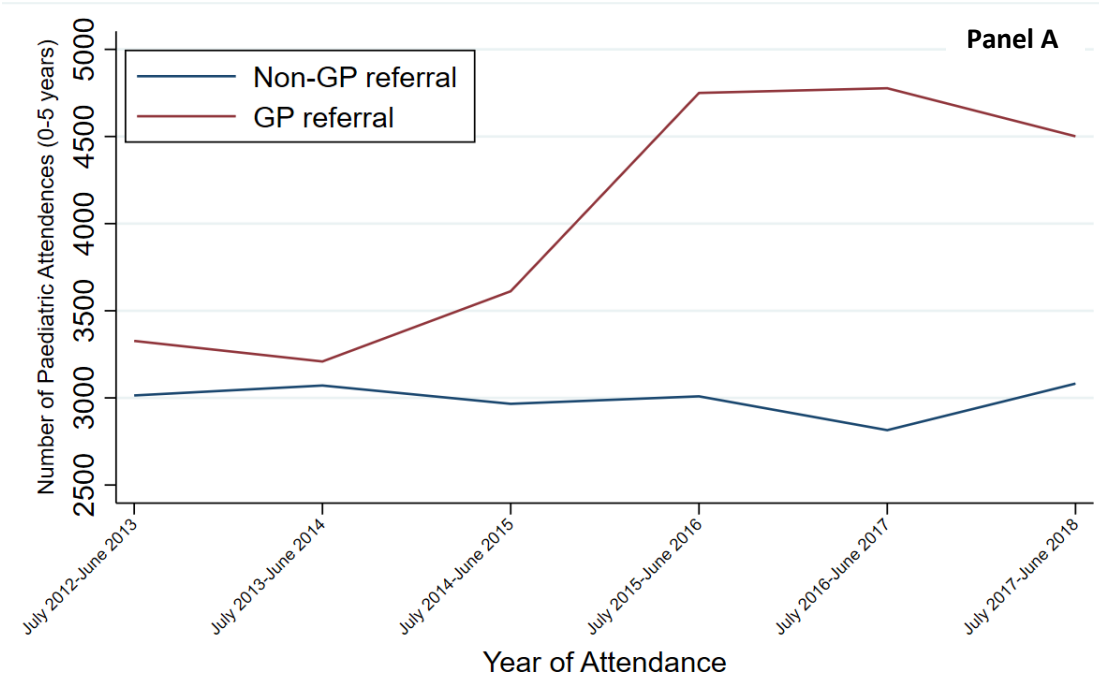
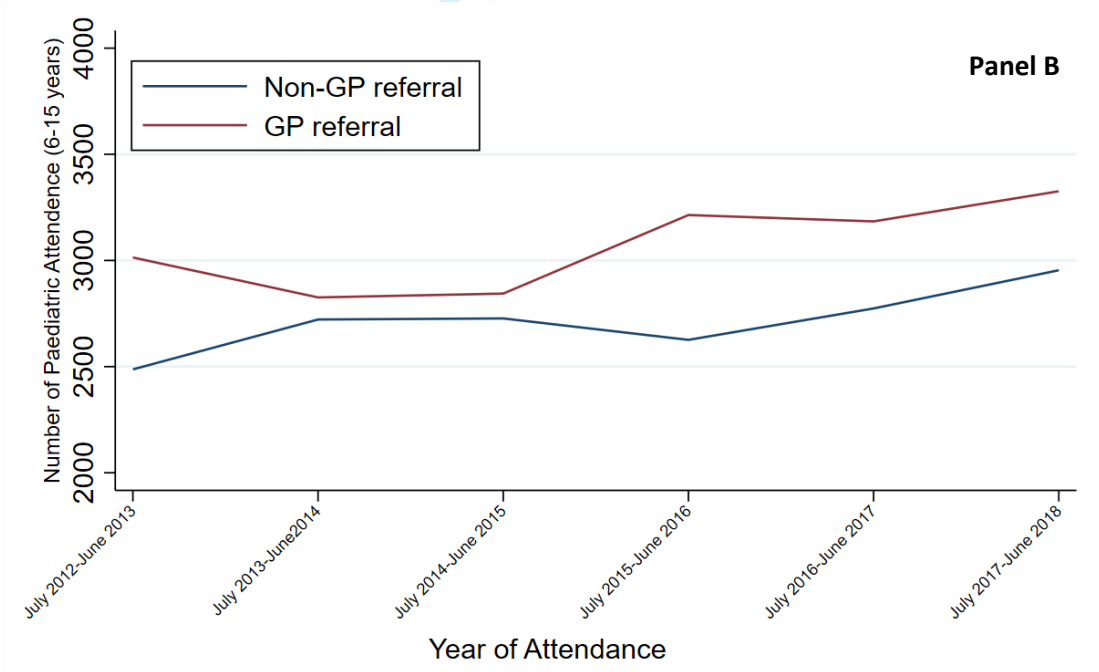
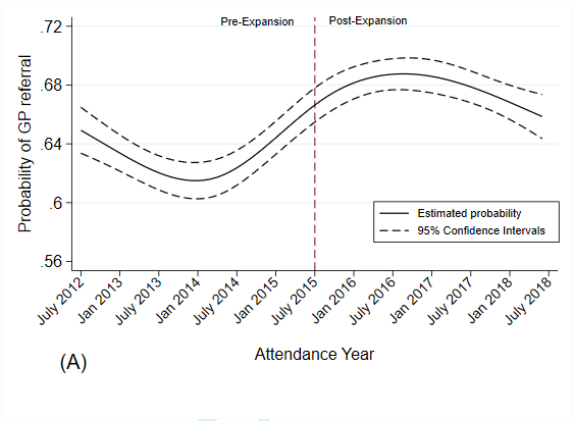



Panel A
Non-GP referral
GP referral
Number of Paediatric Attendences (0-5 years)
2500
3000
3500
4000
4500
5000
July 2012-June 2013
July 2013-June 2014
July 2014-June 2015
July 2015-June 2016
July 2016-June 2017
July 2017-June 2018
Year of Attendance


Panel B
Non-GP referral
GP referral
Number of Paediatric Attendence (6-15 years)
2000
2500
3000
3500
4000
July 2012-June 2013
July 2013-June2014
July 2014-June 2015
July 2015-June 2016
July 2016-June 2017
July 2017-June 2018
Year of Attendance



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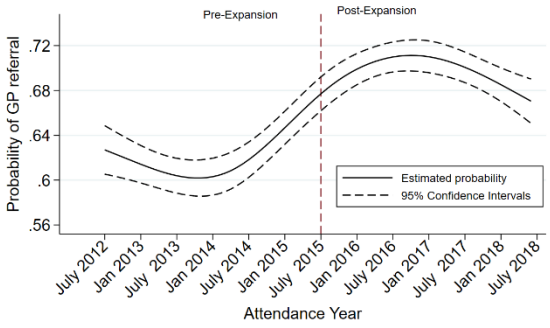

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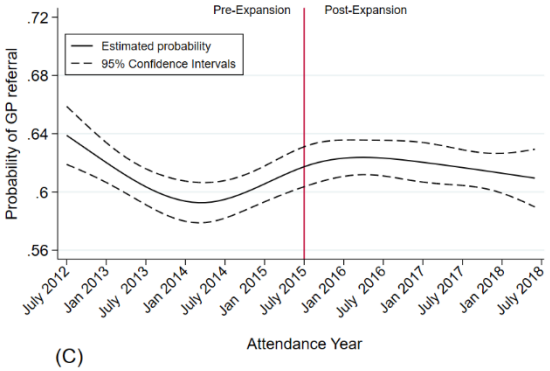
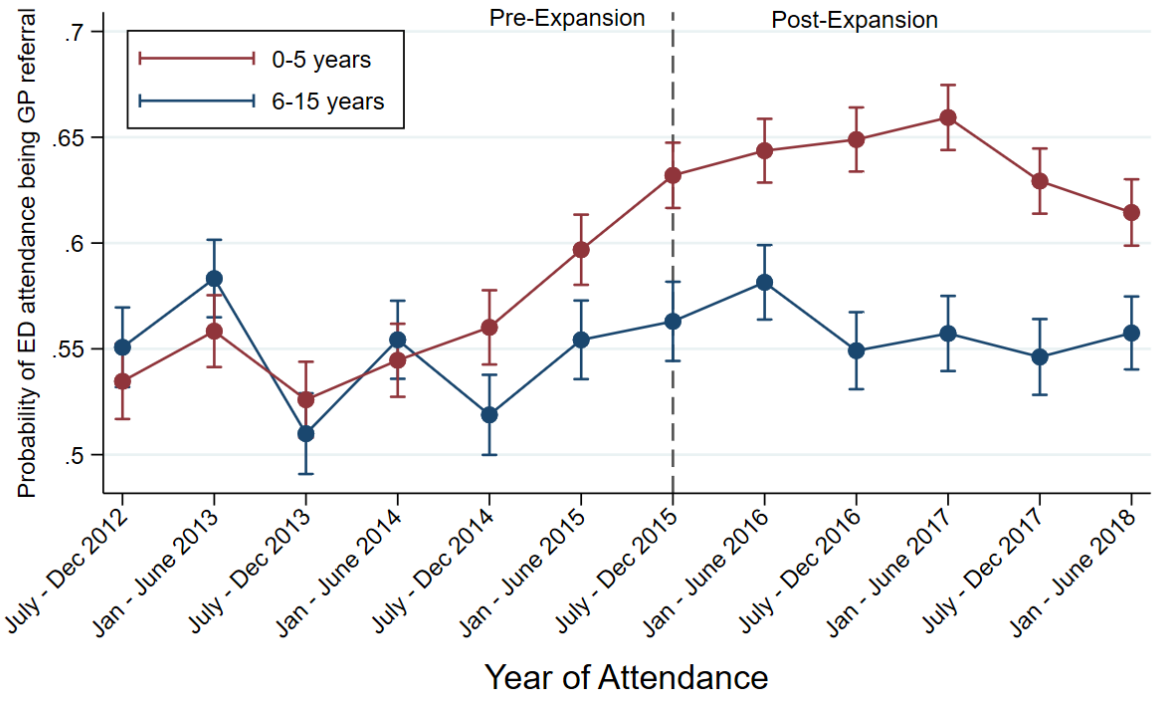
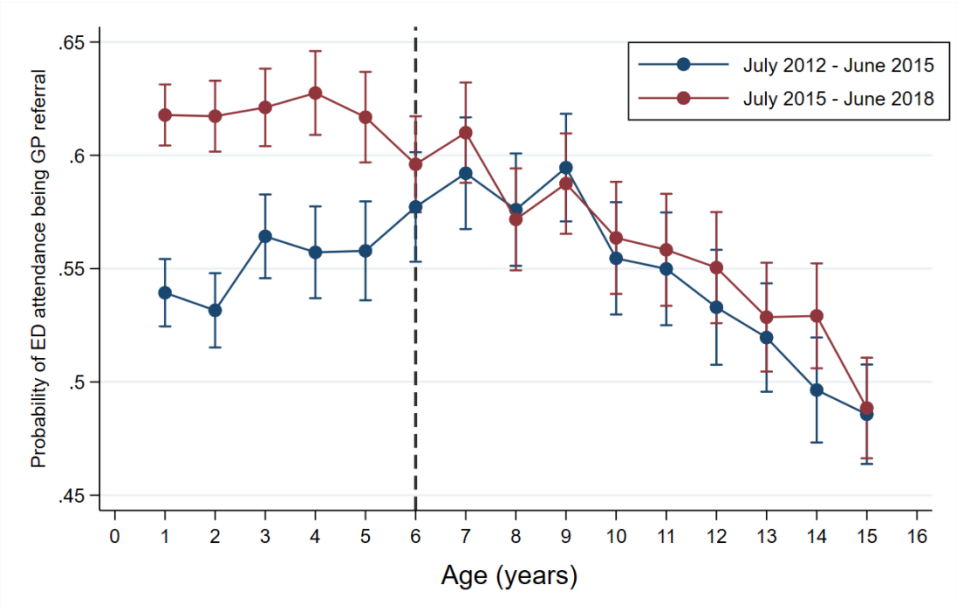
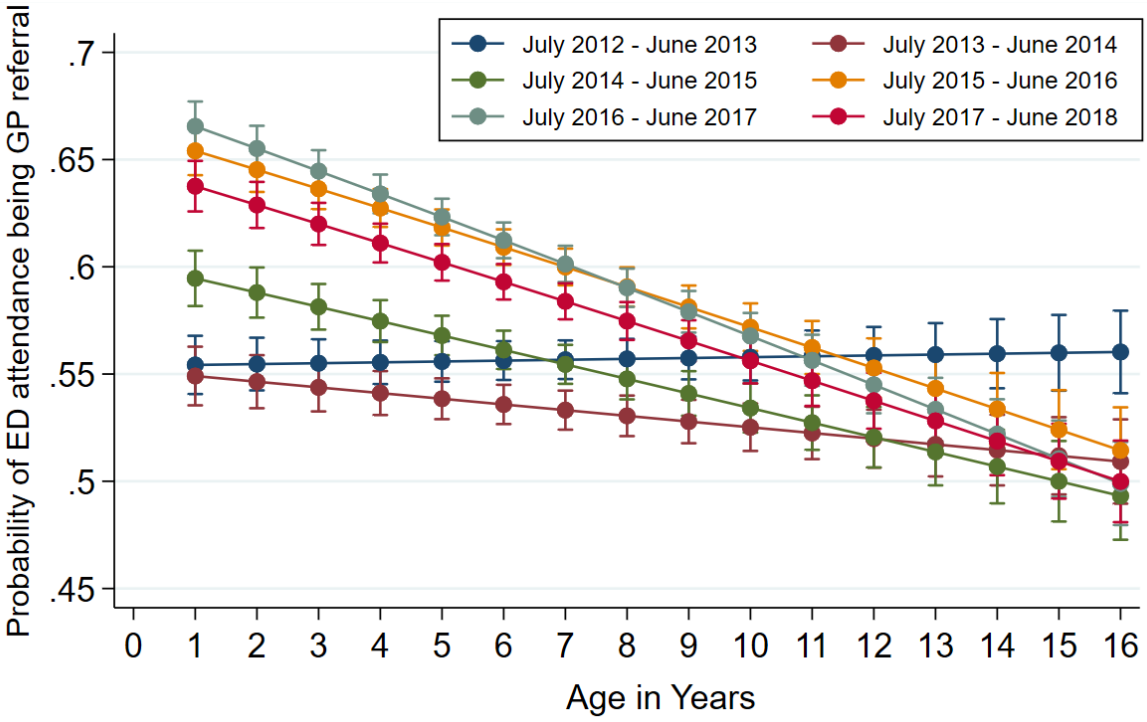
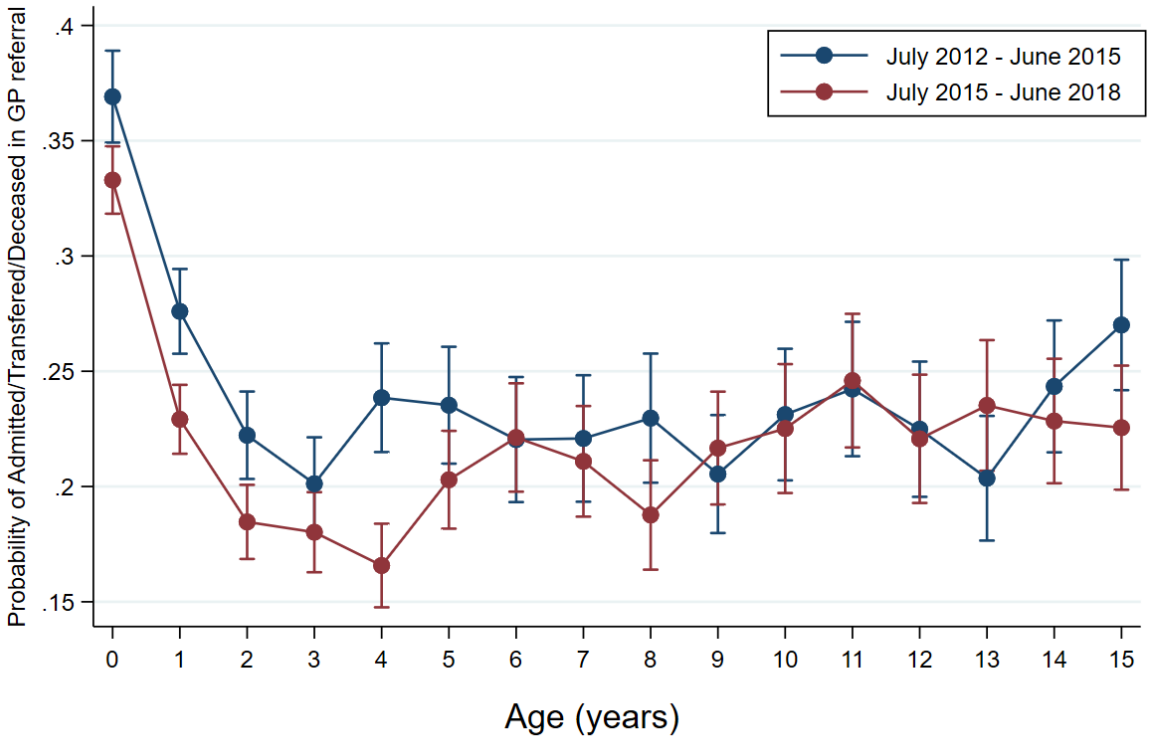


(C)









Supplementary Tables

Table 1. Descriptive statistics of the iPMS data (attendances according to the day of the week and time of the day) for children aged 0-5 and 6-15 years who attended CUH ED during the study period (July 1st 2012 – June 30th 2018).

	0 - 5 years			***6 - 15 years***		
	July 2012 – June 2015	***July 2015 – June 2018***	***P-value[a]***	***July 2012 – June 2015***	***July 2015 – June 2018***	***P-value[a]***
Attendances, n (%)	19,199 (53.6)	22,934 (55.9)		16,620 (46.4)	18,078 (44.1)	
Day of Week (%)						
Sunday	2,635 (13.7)	3,025 (13.2)	0.109	2,065 (12.4)	2,172 (12.0)	0.244
Monday	2,940 (15.3)	3,647 (15.9)	0.097	2,707 (16.3)	2,908 (16.1)	0.610
Tuesday	2,707 (14.1)	3,292 (14.4)	0.456	2,481 (14.9)	2,710 (15.0)	0.807
Wednesday	2,745 (14.3)	3,279 (14.3)	0.999	2,421 (14.6)	2,812 (15.6)	0.010
Thursday	2,746 (14.3)	3,198 (13.9)	0.292	2.441 (14.7)	2,662 (14.7)	0.920
Friday	2,722 (14.2)	3,416 (14.9)	0.038	2,261 (13.6)	2,538 (14.0)	0.241
Saturday	2,704 (14.1)	3,077 (13.4)	0.047	2,244 (13.5)	2,276 (12.6)	0.012
Time (%)						
00:00-05:59	1,529 (8.0)	1,767 (7.7)	0.032	834 (5.0)	905 (5.0)	0.377
06:00-11:59	3,543 (18.5)	4,080 (17.8)	0.078	3,308 (19.9)	3,719 (20.6)	
12:00-17:59	7,440 (38.8)	9,197 (40.1)	**0.005**	6,427 (38.7)	6,999 (38.7)	
18:00-23:59	6,687 (34.8)	7,890 (34.4)	0.359	6,051 (36.4)	6,455 (35.7)	

[a] χ^2 test (2-sided); Bonferroni correction was used for multiple comparisons if *P* was less than 0.05 in the initial χ^2 test for tables larger than 2 x 2. The results that remained statistically significant after the Bonferroni correction are highlighted in bold.