

Themes associated with uncollected paediatric prescriptions at a large tertiary children's hospital: a retrospective, observational study

Chloe Elizabeth Charlotte Williams ^{1,2}, Louise Bracken ³, Andrea Gill ³, Louise Oni ^{2,4}

To cite: Williams CEC, Bracken L, Gill A, *et al*. Themes associated with uncollected paediatric prescriptions at a large tertiary children's hospital: a retrospective, observational study. *BMJ Paediatrics Open* 2024;**8**:e002366. doi:10.1136/bmjpo-2023-002366

► Additional supplemental material is published online only. To view, please visit the journal online (<https://doi.org/10.1136/bmjpo-2023-002366>).

Received 21 November 2023
Accepted 18 June 2024



© Author(s) (or their employer(s)) 2024. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Royal Liverpool and Broadgreen Hospitals NHS Trust, Liverpool, UK

²Department of Women's and Children's Health, University of Liverpool Institute of Life Course and Medical Sciences, Liverpool, UK

³Paediatric Medicines Research Unit, Alder Hey Children's NHS Foundation Trust, Liverpool, UK

⁴Department of Paediatric Nephrology, Alder Hey Children's NHS Foundation Trust, Liverpool, UK

Correspondence to

Dr Louise Oni; louise.oni@liverpool.ac.uk

ABSTRACT

Objective This study aimed to assess the number of prescriptions that were uncollected by caregivers to identify any predisposing systemic themes that may act as barriers to children receiving medications.

Study design and setting Data were retrospectively collected on uncollected prescriptions at a single, tertiary paediatric centre over a 2-month period. This included type and classification of the drug, prescriber specialty, the timing of prescription and the child's registered postcode. Key themes were identified.

Results A total of 124 uncollected prescriptions involving 94 patients were included. 103 (83%) of these were clinic prescriptions, and azathioprine was the most frequently uncollected prescription (n=6, 5%). The uncollected prescriptions most commonly fell under the 'gastrointestinal system' (n=26, 21%) and 'skin' (n=24, 19%) categories, and similarly, 24 (19%) were prescribed by the gastroenterology department and 18 (15%) by dermatology. The mean distance from the child's registered postcode was 8.5±11.8 miles (range 0.5–73.4) with a considerable number of children having a registered postcode greater than 10 miles from the hospital (n=24, 27%). Many children lived in areas corresponding to the lowest decile of the Index of Multiple Deprivation (IMD) (n=38, 42%).

Conclusion Urgent interventions and further prospective studies are needed to minimise the barriers that caregivers face in collecting their child's prescription.

BACKGROUND

Over one billion outpatient prescription items are dispensed from National Health Service (NHS) community pharmacies across England every year, costing over £9 billion annually,¹ however, there are no national statistics evaluating how many dispensed medications are actually collected by patients.

In secondary and tertiary care, outpatient prescriptions are often sent from the clinic to the pharmacy where they are dispensed for patients to collect. While most prescriptions are available for same-day collection, some take longer to be dispensed,

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ There is no data assessing the number of patients who collect their prescriptions from pharmacies in the UK. Identifying themes related to caregivers failing to collect their child's prescription may help address this issue.

WHAT THIS STUDY ADDS

⇒ Both high-risk and low-risk medications may not be collected by caregivers, for reasons that are currently unclear. However, a high proportion of these children are living in the lowest deciles of deprivation, and therefore, socioeconomic circumstances may be an important theme when accessing medication.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

⇒ By identifying barriers to caregivers collecting their child's prescription, there may be an opportunity to intervene by improving access to healthcare. For example, delivering prescriptions to patients who are unable to find the money, time or transport to travel to the hospital.

particularly certain paediatric formulations, sometimes requiring patients to return on a different day. Certain medications can only be obtained from secondary care ('red' medications) and some must be initiated by secondary care before they can be continued by primary care ('amber' medications).² Having fewer, larger, specialist paediatric centres to pool the management of complex, rare conditions, means care can span broad geographical areas. In paediatric specialty services internationally, it is not uncommon for patients to travel several hours for a single hospital visit and if the prescription cannot be dispensed on the same day, this presents an additional cost and inconvenience burden. This likely disadvantages patients who lack access to transport or finances to travel, those who live further from the hospital, potentially



single-parent households and households with multiple children to name a few factors, thus introducing inequalities. The non-collection of 'red' and 'amber' prescriptions is most concerning, however, the non-collection of medications that can be prescribed within the primary care setting or purchased over the counter (OTC) ('green' medications) may still have cost implications for pharmacy departments due to the time spent preparing them for dispensing.

This study aimed to assess the number of prescriptions that were uncollected by caregivers to identify any systemic themes that may act as barriers. These will be used to inform service improvements to increase access to medications for children and improve efficiency within the pharmacy department.

METHODS

Setting

A list of all uncollected prescriptions over a 2-month period was collated from the pharmacy department at a single centre: Alder Hey Children's Hospital (AHCH), Liverpool, UK. AHCH is a 270-bed tertiary paediatric centre located in north-west England and serves a catchment area of 7.5 million children.^{3 4}

Data collection and definitions

Anonymised clinical data were retrospectively collected from electronic health records and recorded on a standardised table. This included the name of the medication, the target system according to the British National Formulary (BNF) classification and traffic light status information as per the Pan Mersey Area Prescribing Committee (APC) (online supplemental figure 1).⁵ The traffic light status recommends who should prescribe a given medication:

- ▶ 'Green' rated medications—those suitable for prescribing in primary or secondary care.
- ▶ 'Red' rated medications—recommended to be prescribed by specialist centres only and should not be prescribed in primary care.
- ▶ 'Amber Recommended' (AR) medications—should only be prescribed by specialists under certain criteria but can then be prescribed by primary care following initiation.
- ▶ 'Amber Initiated' (AI) medications—should be started and continued by a specialist until dose stabilisation then prescribing can be continued within primary care.
- ▶ 'Amber Patient Retained' (A Ret) medications—similar to AI, however, the patient must remain under the care of the specialist indefinitely.

Data collection included the day of the week that the medication was both prescribed and prepared for dispensing; timing of clinic attendance (AM, 09:00–12:30 vs PM, 13:00–17:00) and whether it was virtual (including video call, telephone or email) or face-to-face; the specialty under which the medication was prescribed;

and the child's registered postcode. Indices of deprivation for English postcodes were determined using the 2019 version of the postcode lookup tool,⁶ and a similar tool was used for Welsh postcodes.⁷ A randomly selected control group of patients who did collect their prescriptions over the same period were included for comparison of deprivation data.

Inclusion/exclusion criteria

All uncollected prescriptions were included if they were returned to pharmacy stock between December 2022 to January 2023 and patients were included if there was sufficient information on the electronic health records to perform data analysis. These months were chosen to examine a specific period where the system was most likely to be at its capacity, that is, the winter season, allowing emphasis on the burden of uncollected prescriptions.

Data analysis

Non-parametric, descriptive data was presented as median with range or percentage. The Pearson's χ^2 test and Student t-test were used to determine the difference between IMD deciles for patients who did collect their prescriptions compared with those who did not. This was performed using the Statistical Package for the Social Science (SPSS) V.29.0 software (IBM Corp). A p value of <0.05 was considered statistically significant.

Patient and public involvement

As this study was performed as an audit, patient and public involvement was not included in the study design.

RESULTS

135 uncollected prescriptions over a 2-month period were identified from the initial data set. 11 were excluded as they fell outside the date criteria or had insufficient data, that is, there were no data on the prescriber or the timing of the prescription, or the medication was missing from their electronic records. Therefore, from 01 December 2022 to 31 January 2023, there were 124 uncollected prescriptions across 94 patients (online supplemental figure 2). 103 (83%) uncollected prescriptions were from clinics and 21 (17%) were requested by the caregivers contacting the department directly. Of the clinic prescriptions, 87 (84%) were face-to-face while 16 (16%) were prescribed during virtual clinics. Azathioprine (AZA) was the most frequent uncollected prescription (n=6, 5%).

System classification

The 124 uncollected prescriptions fell into 14 different systems based on the BNF classification (table 1). The uncollected prescriptions most commonly fell under 'gastrointestinal system' (n=26, 21%) and 'skin' (n=24, 19%) classifications.

Table 1 Distribution of uncollected prescriptions by system classification

British National Formulary system classification		Number of uncollected prescriptions, n (%)
1	Gastrointestinal system	26 (21)
13	Skin	24 (19)
3	Respiratory system	10 (8)
9	Nutrition and blood	9 (7)
5	Infections	8 (7)
8	Malignant disease and immunosuppression	8 (7)
11	Eye	8 (7)
2	Cardiovascular system	7 (6)
7	Obstetrics, gynaecology, and urinary-tract disorders	5 (4)
12	Ear, nose and oropharynx	5 (4)
4	Central nervous system	4 (3)
6	Endocrine system	4 (3)
10	Musculoskeletal and joint diseases	4 (3)
18	Preparations used in diagnosis	2 (2)

Most medications (n=65, 52%) were ‘green’ rated, 12 (10%) were AR, 20 (16%) were AI, 2 (2%) were A Ret medications and 20 (16%) were ‘red’ rated medications. A small proportion (n=5, 4%) of prescriptions had a mixed status of ‘green’ rated for patients aged over 12 years and AR for patients under 12 years.

Drug route and preparation

Most medications were orally administered. Most were tablets (n=32, 25%), followed by liquid or suspension formulations (n=25, 20%), capsules (n=9, 7%) and powder for solution (n=9, 7%). In one case, both liquid and tablet preparations were prescribed (table 2).

Prescriber speciality

The uncollected prescriptions spanned 21 specialties. Most were from gastroenterology (n=24, 19%) followed by 18 (15%) from dermatology; 13 (10%) from urology; 9 (7%) from endocrinology; 8 (6%) from each of accident and emergency (A&E) and ophthalmology; and 6 (5%) each from allergy and general paediatrics. The full distribution is detailed in figure 1.

Timing of uncollected prescriptions

The uncollected medications were most frequently prescribed on Monday and Wednesday (n=32, 26%), followed by Thursday (n=27, 22%), Friday (n=20, 16%) and Tuesday (n=12, 10%). None were prescribed over the weekend. The distribution of when the medications were prepared for dispensing differed (figure 2), with most medications being prepared for dispensing on a Wednesday (n=29, 23%), and conversely, some

Table 2 Number of uncollected prescriptions for each route of administration and drug formulation

Route and/or drug preparation	Number of uncollected prescriptions, n (%)
Oral	78 (63)
Tablet	31
Liquid or suspension (including drops)	25
Capsule	9
Powder for solution	9
Granules	1
Powder	1
Spray	1
Tablet and liquid prescribed	1
Topical	26 (21)
Cream	10
Ointment	9
Lotion	4
Gel	3
Ocular	7 (6)
Inhaled	3 (2)
Nasal	3 (2)
Rectal	3 (2)
Intramuscular	2 (2)
Subcutaneous	2 (2)

were prepared for dispensing on a Saturday or Sunday (both n=2, 2%). Most medications were prepared for dispensing on the same day they were prescribed (n=76, 61%) with a small number being dispensed the following day (n=4, 3%). Ten medications took longer than a week to be dispensed (n=10, 8%). The median number of days from prescription to dispensing was 0 (range 0–57). Among the uncollected clinic prescriptions, there were a similar number of events from the morning or afternoon clinics (n=55, 53%; n=48, 47%, respectively).

Postcode and Index of Multiple Deprivation

Of the 94 patients, 91 lived in England and 3 in Wales. A third of patients (n=29, 31%) lived outside the Merseyside region; 12 (41%) from Warrington; 4 (14%) each from Cheshire and Preston; 3 (10%) from Shrewsbury; and the remainder from Crewe (n=2, 7%), Llandudno (n=2, 7%), Blackpool (n=1, 3%) and Stockport (n=1, 3%). The mean distance from the child’s registered postcode to AHCH was 8.5±11.8 miles (range 0.5–73.4), with 37 (39%) children living more than 5 miles from AHCH and 24 (27%) living more than 10 miles. Comparatively, we included a random selection of 92 children who did collect their prescription and found no significant difference between the two groups (9.0±12.8 miles, range 0.7–73.4, p>0.05).

Of the 91 English postcodes, many were in the lowest decile of the Index of Multiple Deprivation (IMD) (n=38,

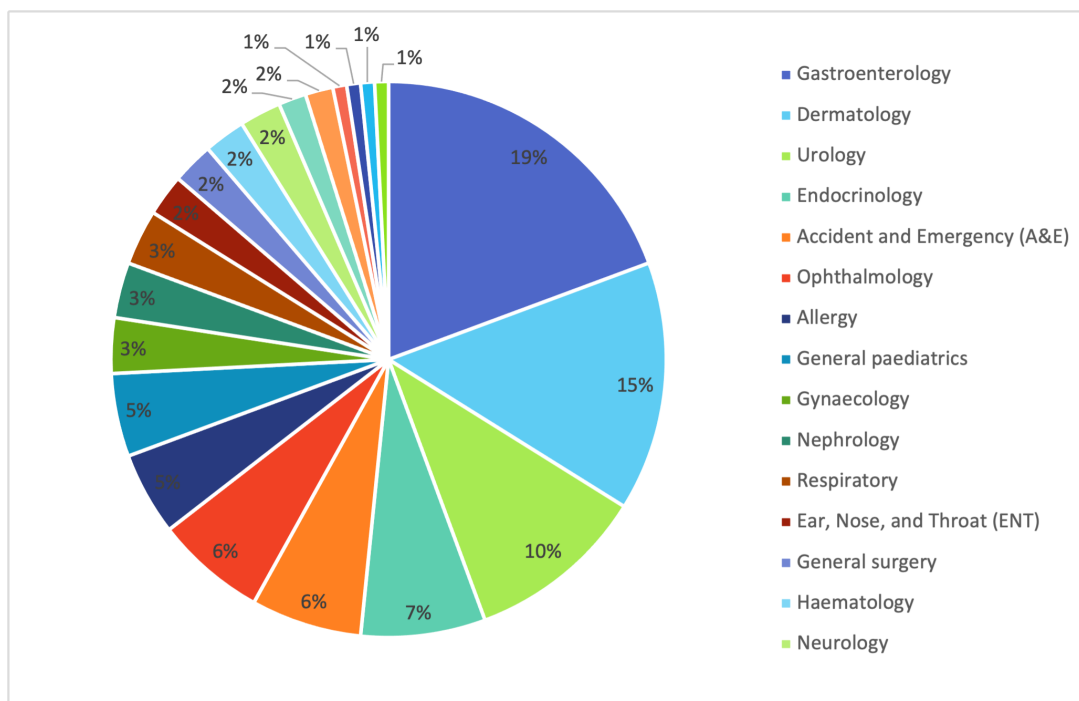


Figure 1 The distribution of uncollected prescriptions among different specialties at Alder Hey Children's Hospital is shown.

42%) and 70 (77%) were in the lowest five IMD deciles. There were three Welsh postcodes: one (33%) in each of the 2nd, 3rd and 10th Welsh IMD deciles. There was no significant difference between the IMD distribution of the two groups ($p > 0.05$, table 3).

DISCUSSION

In this single-centre study, we assessed the number of paediatric prescriptions that were uncollected by

caregivers over a 2-month period. Across 124 uncollected prescriptions, we found that AZA was the most frequently uncollected prescription ($n=6$) and an EPIPEN ($n=1$) was the most critical uncollected prescription. Most uncollected prescriptions fell under 'dermatology' or 'gastroenterology' system classifications; most were 'green' rated; timing of the prescription or preparation for dispensing did not appear significant; a third of children had a postcode registered outside the Liverpool

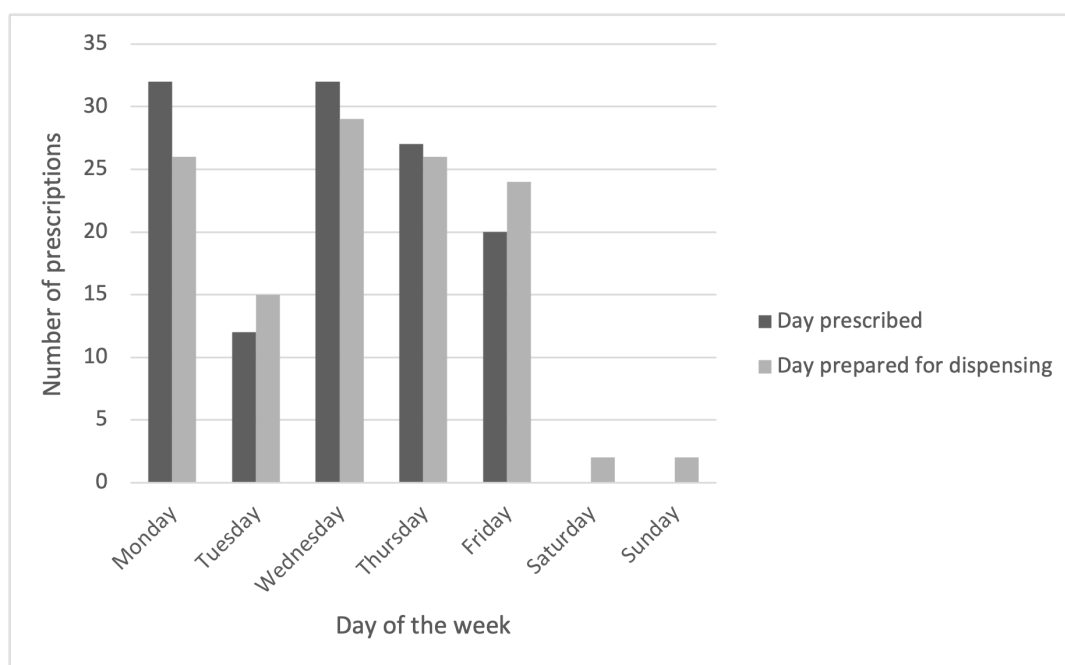


Figure 2 The distribution of medications prescribed and dispensed across the week.

Table 3 The number of uncollected prescriptions vs the number of collected prescriptions across each IMD decile in England and Wales

Index of Multiple Deprivation (IMD) decile in England and Wales	Uncollected prescriptions, n (%)	Collected prescriptions, n (%)	P value
1	38 (40)	39 (42)	>0.05
2	14 (15)	12 (13)	>0.05
3	7 (7)	6 (7)	>0.05
4	7 (7)	4 (4)	>0.05
5	6 (6)	11 (12)	>0.05
6	2 (2)	1 (1)	>0.05
7	5 (5)	5 (5)	>0.05
8	5 (5)	6 (7)	>0.05
9	6 (6)	4 (4)	>0.05
10	4 (4)	4 (4)	>0.05

There were no statistically significant differences between IMD deciles.

region; and many (42%) uncollected prescriptions were for children registered to a postcode in the lowest IMD decile, however, this proportion was reflected in the control group.

The two most common specialties with uncollected prescriptions were gastroenterology and dermatology (n=26, 21%; n=24, 19%, respectively) and these were the two most common prescriber specialties (n=24, 19%; n=18, 15%, respectively). This may be due to the number of laxatives and emollients prescribed which are 'green' rated medications, therefore obtainable from the GP or community pharmacies. Laxatives and emollients may also not be considered critical medications by caregivers therefore less likely to be collected. An important number of the medications (16%) were 'red' rated. As caregivers are not able to access these medications elsewhere, it may again highlight concerns surrounding medication use and therefore uncollected prescriptions may represent a surrogate marker for medication non-adherence. It may also imply a lack of understanding of the importance of taking medications secondary to language and cultural barriers or caregiver education, digital exclusion, caregiver burnout from meeting the needs of a child with chronic illness or safeguarding concerns if caregivers are not providing their child with appropriate health-care.⁸ Forgetfulness and cognitive impairment have been demonstrated in patients with burnout⁹ and may also affect caregivers given the burden of caring for children with complex health needs.^{10–12} Pharmacies often implement electronic reminder systems, however, this relies on good access to technology and the ability to obtain the medication. The barriers for each patient may be unique however need to be minimised for optimisation of health outcomes.¹³

The most frequent uncollected prescription was AZA (n=6, 5%) and all were prescribed by gastroenterologists. AZA is a disease-modifying anti-rheumatic drug commonly used in the management of inflammatory

bowel disease (IBD) and is a high-risk, 'red' rated medication. Of these six prescriptions, the distance of the child's registered postcode was overall greater than the rest of the cohort (median 22.6 vs 3.9 miles). AZA is a long-term therapy, therefore at risk of non-adherence which may include not collecting the prescription and can lead to suboptimal health outcomes.⁸ While no previous studies have analysed rates of collection from pharmacy, one study identified an AZA non-adherence rate of 24.5% of adults with IBD.¹⁴ A further study identified a high rate (36.2%) of non-adherence to AZA-6-mercaptopurine combination therapy in paediatric IBD,¹⁵ with identified themes including doubts that their child's future health would depend on the medication (61.7%), doubts that the medication would protect their child from becoming worse (51.1%) and doubts their child would become very ill without the medication (48.9%). This highlights the need for a better caregiver and patient education on the importance of adherence to prescribed medications and therefore the collection of them, as well as drug acceptability to patients and families to maximise drug adherence in at-risk populations.

If uncollected prescriptions are a true indication of medication non-adherence, this may highlight concerns surrounding the acceptability of the medication to the child and/or caregiver. There was an important proportion (20%) of uncollected medications that were liquid preparations that would commonly be prescribed as tablets or capsules in adult populations. Liquid preparations are significantly more expensive to manufacture than their tablet or capsule counterparts and despite a long-standing belief that liquid medicines are the most acceptable for children, evidence has suggested that solid dosage forms may be better to mask the taste of the medicine, with a better stability profile and a lower number of excipients.^{16,17} Children and young people can be taught to swallow tablets, and acceptability of a drug for patients and their caregivers is critical for medication adherence.



Improving accessibility to tablets through ‘pill school’ programmes such as KidzMed may provide potentially huge long-term benefits including cost reductions and accessibility to novel drugs.¹⁸ If tablets or capsules are prescribed as standard for most children, there may be an overall cost reduction if medications are not collected. Additionally, once liquid medications are opened and dispensed, they cannot be returned to stock if they are not collected and there is a limited frame within which the remaining medication must be used, otherwise it will be discarded. Moving away from the use of liquid medications may help improve acceptability to patients, medication adherence and therefore collection of the prescription which may overall reduce the burden of medication waste. In cases of polypharmacy, it may be beneficial to introduce a system where caregivers can provide the pharmacy team with a list of the types and quantities of medications they have at home to cross-reference with the most up-to-date prescriptions to minimise duplicate prescriptions and medication waste.

We identified a high number of patients with registered postcodes outside the Liverpool area (31%) and a striking number of patients whose postcode was within the lowest IMD decile (42%). However, there was no significant difference in the number of children living in each IMD decile compared with our control group. Despite this, our study has still shown that AHCH serves a significant proportion of children who live in poverty, which may be a theme to consider when addressing barriers to collecting prescriptions. In 2019, Liverpool was ranked second nationally based on the percentage of lower super output areas (LSOAs) in the 10% most deprived of the country, that is, 48.7% of LSOAs were in the first IMD decile.¹⁹ The Liverpool City Region has over 80 000 children living in poverty and therefore optimising access to healthcare, including the ability for caregivers to collect their child’s prescriptions, is vital in improving medication adherence and clinical outcomes. In children with multimorbidity, the financial implication of chronic disease including travelling to collect medications can be huge, contributing to lifelong disadvantage¹³ and health disparities into adulthood, perpetuating the cycle of deprivation and poorer health outcomes.^{20–23}

Limitations

This study does have limitations that should be acknowledged. First, we did not assess the overall demand and number of outpatient clinics during this 2-month period, therefore, it is unclear whether the findings of this study are representative of a full year at AHCH or whether there is seasonal variation. Similarly, we did not examine the overall number and number of individual drug prescriptions, which were prescribed by each specialty and collected within this time frame; therefore, it is difficult to evaluate the true burden of the uncollected prescriptions. Limitations of this audit also include its retrospective nature. Additionally, the study did not capture the patient perspective, therefore, it is difficult

to suggest ways to improve our current system. This, alongside missing data, meant we did not know if these uncollected prescriptions were re-dispensed, bought at an alternative community pharmacy or prescribed by the GP so this may affect the validity of our results.

Next steps

A prospective analysis including patient and caregiver views is urgently needed to address the underlying barriers to collecting prescriptions for children. These data are vital in identifying which prescriptions may not need to be dispensed by the outpatient pharmacy, thereby reducing workload. If the medication was not obtained elsewhere, a prospective audit would also further explore the individual barriers to caregivers not collecting their child’s prescriptions as well as ways to improve accessibility.

CONCLUSION

This pilot study has identified some key themes relating to uncollected outpatient prescriptions at a tertiary paediatric centre, including distance from the hospital and medications classified under ‘dermatology’ or ‘gastroenterology’, including AZA. While ‘green’ rated were more commonly uncollected, the impact of uncollected ‘red’ rated medications is important to consider. Low IMD decile in this population was significant however not unique to the patients whose prescriptions were not collected. Urgent interventions are needed to minimise barriers to collecting prescriptions, including further prospective analysis to gather information on the patient and caregiver perspectives.

X Chloe Elizabeth Charlotte Williams @ChloeECWil

Contributors AG and LB devised the main conceptual idea for the study and provided the initial dataset. CECW performed the data enrichment, data analysis and took the lead in writing the manuscript. LO acted as the primary supervisor and guarantor, and all authors contributed to the final version of the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The study was performed as a locally approved audit (Alder Hey Children’s Hospital Clinical Governance Department, audit registration number 6827), however, as it did not involve human participants and only retrospective data collection, it did not require ethical approval as per the Health Research Authority (HRA) for NHS England.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. All data are presented in the manuscript. Any raw data will be made available upon reasonable request to the corresponding author.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability

of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Chloe Elizabeth Charlotte Williams <http://orcid.org/0000-0002-9276-0255>

Louise Bracken <http://orcid.org/0000-0002-9632-2252>

Andrea Gill <http://orcid.org/0000-0002-8198-1028>

Louise Oni <http://orcid.org/0000-0002-1532-2390>

REFERENCES

- NHS Business Authority. Prescription cost analysis England 2020/21. 2021. Available: https://nhsbsa-opendata.s3.eu-west-2.amazonaws.com/pca/pca_summary_narrative_2020_21_v001.html
- RAG criteria: NHS pan mersey area prescribing committee, Available: <https://www.panmerseyapc.nhs.uk/formulary/rag-criteria>
- Commission CQ. Alder hey children's hospital quality report. 2015.
- Trust AHCsHNF. Our hospital. Available: <https://alderhey.nhs.uk/healthier-future/alder-hey-park/our-hospital>
- Pan Mersey Formulary: NHS pan Mersey area prescribing committee. 2022. Available: <https://www.panmerseyapc.nhs.uk/formulary>
- English indices of deprivation 2019: ministry of housing communities & local Government. 2019. Available: <https://imd-by-postcode.opendatacommunities.org/imd/2019>
- Welsh index of multiple deprivation: statswales.gov.wales, 2019. Available: <https://statswales.gov.wales/Catalogue/Community-Safety-and-Social-Inclusion/Welsh-Index-of-Multiple-Deprivation>
- El-Rachidi S, LaRoche JM, Morgan JA. Pharmacists and pediatric medication adherence: bridging the gap. *Hosp Pharm* 2017;52:124–31.
- Sandström A, Rhodin IN, Lundberg M, *et al*. Impaired cognitive performance in patients with chronic burnout syndrome. *Biol Psychol* 2005;69:271–9.
- Broxson J, Feliciano L. Understanding the impacts of caregiver stress. *Prof Case Manag* 2020;25:213–9.
- Gérain P, Zech E. Informal caregiver burnout? Development of a theoretical framework to understand the impact of caregiving. *Front Psychol* 2019;10.
- Gérain P, Zech E. A harmful care: the association of informal caregiver burnout with depression, subjective health, and violence. *J Interpers Violence* 2022;37:9738–62.
- Blair JC, Aitken C, Smith J, *et al*. Socioeconomic barriers preventing children and young people living with long-term health conditions from achieving optimal outcomes. *Arch Dis Child* 2023;108:685–6.
- Viazis N, Vlachogiannakos J, Georgiadis D, *et al*. Azathioprine use in patients with inflammatory bowel disease. adherence to treatment and adverse events. a single center experience. *Ann Gastroenterol* 2009;22.
- Alsous MM, Hawwa AF, Imrie C, *et al*. Adherence to azathioprine/6-mercaptopurine in children and adolescents with inflammatory bowel diseases: a multimethod study. *Can J Gastroenterol Hepatol* 2020;2020.
- Hori KS, Siu AM, Yamamoto LG. Replacing liquid antibiotics with cheaper pill equivalents: an opportunity for substantial savings. *Clin Pediatr (Phila)* 2018;57:1294–9.
- Bracken L, McDonough E, Ashleigh S, *et al*. Can children swallow tablets? outcome data from a feasibility study to assess the acceptability of different-sized placebo tablets in children (creating acceptable tablets (CAT)). *BMJ Open* 2020;10.
- Kidzmed: elfh. 2020. Available: <https://www.e-elfh.org.uk/programmes/kidzmed>
- Bowie P. The English indices of deprivation. 2019.
- Taylor-Robinson DC, Diggle P, Smyth R, *et al*. *A Life Course Perspective on Health Trajectories and Transitions*. Springer, 2015.
- Shackleton N, Hale D, Viner RM. Trends and socioeconomic disparities in preadolescent's health in the UK: evidence from two birth cohorts 32 years apart. *J Epidemiol Community Health* 2016;70:140–6.
- Taylor-Robinson DC, Smyth R, Diggle PJ, *et al*. A longitudinal study of the impact of social deprivation and disease severity on employment status in the UK cystic fibrosis population. *PLoS One* 2013;8.
- Alsallakh MA, Rodgers SE, Lyons RA, *et al*. Association of socioeconomic deprivation with asthma care, outcomes, and deaths in wales: a 5-year national linked primary and secondary care cohort study. *PLoS Med* 2021;18.