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Abstract

Background

Clinical guidelines recommend that patients admitted to hospital for asthma attacks are reviewed in primary care following hospital discharge.

Aim

We evaluated post-hospitalisation asthma management in primary care and its associations with patient characteristics.

Design and setting

A retrospective cohort study was performed using English primary care data from the Clinical Practice Research Datalink Aurum database and linked Hospital Episode Statistics Admitted Patient Care data.

Method

Patients with asthma aged ≥5 years who had at least one asthma-related hospitalisation from 1st January 2017 to 31st December 2019 were included. The primary outcome was a composite of any of the following delivered in primary care within 28 days from hospital discharge: asthma review, asthma management plan, asthma medication prescriptions, demonstration of inhaler technique, or smoking cessation counselling. The association between patient characteristics and delivery of clinical care was assessed using logistic regression.

Results

The study included 17,457 patients. 10,515 (60.2%) patients received the primary outcome within 28 days of hospital discharge. 2311 (13.2%) received an asthma review, 1459 (8%) an asthma management plan, 9996 (57.3%) an asthma medication, 1500 (8.6%) a demonstration of inhaler technique, and 52 (1.2% of smokers) had smoking cessation counselling. Patients from black ethnic minorities received less of this care (27-54% lower odds, depending on age). However, short-acting bronchodilator prescriptions in the previous year were associated with an increased likelihood of the primary outcome.

Conclusion

A significant proportion of patients do not receive timely follow-up in primary care following asthma-related hospitalisations, particularly among black ethnic groups.

Keywords

Asthma, management, post-hospitalisation, primary care, cohort study.

How this fits in

Asthma is a common cause of hospital admissions and clinical guidelines recommend that hospitalised patients are followed up in primary care. Little research has been done on

evaluating post-hospitalisation asthma management in primary care. We found that 40% of hospitalised patients did not receive asthma management in primary care following hospital discharge, particularly among patients from black ethnic minority groups. Primary and secondary care services should develop systems for ensuring the timely follow-up of asthma patients after hospital discharge and address the observed health inequities.

Introduction

Asthma is a common chronic disease in children and adults and is responsible for considerable healthcare use.(1) 5.4 million people in the UK were actively receiving treatment for asthma in 2020.(2) Asthma accounts for 2-3% of primary care consultations,(3) 60,000 hospitalisations with 200,000 bed-days per year and is estimated to cost £1.1 billion a year to UK health services.(4) It is also an important cause of poor quality of life.(5)

Asthma-related hospitalisations remain high in the UK despite efforts to improve care. Clinical guidelines recommend that patients hospitalised for asthma attacks are reviewed in primary care within 48 hours of hospital discharge,(6)(7) since the risk of subsequent exacerbations is higher among these patients.(8)(9)

In the UK, asthma patients are mostly followed up in primary care, and high-risk patients are expected to receive comprehensive post-exacerbation care including an asthma review, asthma management plan, and assessment of inhaler technique.(7)(10)(11) Although extensive evaluations of in-hospital asthma care have previously been conducted,(12) there has been little evaluation of post-hospitalisation follow-up in primary care.(13)
Our study aimed to evaluate post-hospitalisation asthma management in primary care and to assess the association with patient characteristics.

Methods

Study Design

A retrospective cohort study was conducted among patients hospitalised with asthma to assess post-hospitalisation primary care management using routinely collected primary and secondary care data. We also assessed the association between patient characteristics and the likelihood of receiving post-hospitalisation asthma management in primary care. This was part of the Preventing Unscheduled Hospitalisations in Asthma (PUSH Asthma) study.(14)

Setting

We used primary care data from the Clinical Practice Research Datalink (CPRD) Aurum database, which contains longitudinal, routinely collected electronic health record data from UK primary care practices. 16% of the general practices in the UK which use the EMIS clinical information system contribute to this database. CPRD Aurum covers 19% of the UK population and includes information on diagnoses (recorded using SNOMED-CT codes) and drug prescriptions.(15) We also used linked Hospital Episode Statistics Admitted Patient Care (HES APC) data, which is coded using ICD-10 codes. Primary care data extraction was done using the Data Extraction for Epidemiological Research (DExtER) tool.(16)

Participants

Eligible patients were aged five years and older with a diagnosis of asthma prior to 1st January 2017 (index date), registered with a general practice contributing to CPRD Aurum at least one year prior to the index date, and hospitalised for asthma during the study follow-up period (1st January 2017 to 31st December 2019).

Asthma was defined as the presence of a SNOMED-CT code for asthma (see supplementary table 1 for SNOMED-CT codes). Asthma-related hospitalisation was defined by the presence of an ICD-10 asthma diagnosis code (J45- 46) as the primary diagnostic code in the linked HES APC data.

Patients who had diagnoses of Chronic Obstructive Pulmonary Disease (COPD), bronchiectasis, obstructive sleep apnea and Interstitial Lung Disease (ILD) in addition to asthma were excluded from the analysis due to the potential for misclassification bias. Diagnoses were identified as a clinical code for each condition at baseline.

Baseline variables

Baseline data were extracted to describe demographic characteristics (age, sex, ethnic group, socioeconomic status measured by the Index of Multiple Deprivation [IMD] quintiles), behavioural risk factors (body mass index [BMI] and smoking status [for adolescents and adults only]) and relevant comorbidities (allergies, atopic eczema, allergic rhinitis, gastroesophageal reflux disease [GORD], chronic rhinosinusitis, anxiety, and depression) prior to the index date.

Age was determined at the index date. BMI was determined by the latest recorded value prior to the index date. Where patients had more than one entry for smoking status in the same record, the most recent smoking status recorded was used. For rare cases where a patient's most recent smoking status was "non-smoker" but also had an ex-smoker/smoker code in the same record, the patient was classed as an ex-smoker.

Asthma-related drug prescriptions within one year prior to the index date were extracted for the following medications: short-acting beta 2 agonists (SABA), oral corticosteroids (OCS), inhaled corticosteroids (ICS), long-acting beta 2 agonists (LABA), long-acting muscarinic antagonists (LAMA), leukotriene receptor antagonists (LTRA), and influenza vaccination.

Asthma-related hospitalisations within one year prior to the index date were also extracted.

Clinical code lists for all conditions were created using a systematic process with clinical input that involved checking existing code lists used by our research team, checking published code lists, searching the SNOMED-CT terminology browser, and searching using free text terms within an inhouse software tool called Code Builder. SNOMED-CT code lists for clinical diagnoses are published on GitHub (https://github.com/annalhead/CPRD_multimorbidity_codelists/tree/main/codelists) and in Supplementary tables 2-6.

Outcomes

The following aspects of asthma care were extracted from primary care records for within 48 hours, 7 days, and 28 days of hospital discharge: provision of an asthma review, asthma management plan, prescriptions of asthma medications (SABA, OCS, ICS, LABA, LAMA, LTRA), demonstration of inhaler technique, and smoking cessation counselling. The primary outcome was a record of any of these items of care being recorded within 28 days following the date of hospital discharge.

We also assessed changes in inhaler medications post-hospital discharge by comparing the drug class of prescriptions recorded in the year before the hospital admission and those prescribed within 28 days after the hospital discharge.

Study size

We used the maximum number of eligible patients available in the database and study size was not determined by a formal sample size calculation.

Quantitative variables

Variables were categorised into the following groupings: age (5-11, 12-17, 18-24, 25-39, 40-59, 60-79 and ≥80 years), ethnic group (white, black, mixed, Asian, other, missing), IMD score quintile (1 [least deprived], 2, 3, 4, 5 [most deprived]), BMI (<18.5kg/m^2 [underweight], 18.5-24.9 kg/m^2 [normal weight], 25-29.9 kg/m^2 [overweight], >30 kg/m^2 [obese], missing), smoking status (current smoker, former smoker, never smoked, missing), SABA prescriptions (0, 1-3, 4-6, ≥7 prescriptions), and number of hospital admissions within the previous year (0, 1-3, 4-6, ≥7).

Statistical analysis

We stratified the cohort into children (5-11 years), adolescents (12-17 years) and adults (≥18 years). Baseline characteristics and outcomes for each age stratum were described using simple descriptive statistics. Missing data were addressed using a 'missing' category for each categorical variable. The primary outcome was presented as the proportion of hospitalised patients who received asthma management within 28 days of hospital discharge. Secondary outcomes were asthma management within 48 hours and 7 days of discharge. The associations between the primary outcome and patient characteristics were assessed using logistic regression, adjusted for demographic and clinical factors. Data analyses were done using Stata SE V.16 and R Studio.

Results

Participants

The study included 17,457 patients who had at least one asthma-related hospitalisation during the study period. This included 2,512 children, 1,511 adolescents and 13,434 adults. Their baseline characteristics are shown in Table 1.

The median age was 9 years (interquartile range [IQR] 8-10 years) for children, 15 years (IQR 13-16 years) for adolescents, and 49 years (IQR 34-64 years) for adults. 11,264 (65%) were female. The majority (62%) were of white ethnicity followed by 1978 (11%) Asians and 876 (5%) black ethnic groups. 2943 (17%) had missing ethnicity data. 5006 (29%) were from the most deprived socioeconomic quintile.

 9901 (57%) overall were overweight or obese. 176 (12%) adolescents and 4093 (31%) adults were current smokers. The most common comorbidity was atopic eczema for children (1392/2512 [55%]) and adolescents (871/1511 [58%]) and depression for adults (6432/13,434 [48%]).

Within the previous year, 13885 (79%) had received a SABA, 13548 (78%) an ICS, 8573 (49%) an OCS and 3894 (22%) a LTRA. 8948 (51%) had not received an influenza vaccine within the previous year. 953 (5%) had experienced one or more asthma-related hospital admissions within the previous year.

Outcomes

Post-hospitalisation asthma management is summarised in table 2.

1473 (59%) of children received at least one form of asthma management within 28 days of hospital discharge. This was even lower within 7 days (834/2512, [33%]) and 48 hours (453/2512 [18%]) post-hospital discharge. 257 (10%) received an asthma management plan, 391 (16%) had an asthma review, and 227 (9%) had a demonstration of inhaler technique within 28 days of hospital discharge. 1391 (55%) of children received at least one asthma medication prescription within 28 days of hospital discharge, of which SABA was the most prescribed (1073/2512 [43%]).

880 (58%) of adolescents received some form of asthma management within 28 days of hospital discharge. Again, this was lower within 7 days (483/1511 [32%]) and 48 hours (270/1511 [18%]) from hospital discharge.156 (10%) had been provided with an asthma management plan, 222 (15%) had an asthma review, 138 (9%) had a demonstration of inhaler technique, and only 3 (2%) current smokers were offered smoking cessation counselling within 28 days of hospital discharge.828 (55%) of adolescents received asthma medication prescriptions within 28 days of hospital discharge, with SABA again being the most prescribed.

8162 (61%) of adults received some form of asthma management within 28 days of hospital discharge. Again, this was lower within 7 days (4262/13434 [32%]) and 48 hours (1862/13434 [14%]) from hospital discharge.1046 (8%) had been provided with an asthma management plan, 1698 (13%) had an asthma review, 1135 (8%) had a demonstration of inhaler technique, and only 49 (1%) of current smokers had been offered smoking cessation counselling within 28 days of hospital discharge.7777 (58%) of adults received asthma medication prescriptions within 28 days of hospital discharge, with ICS being the most prescribed. .

9% of children (220/2512) and adolescents (134/1511) had a change in their inhaler medication within 28 days of hospital discharge (supplementary table 7), with the main change being the addition of ICS. 1840 (14%) of adults had a change in their inhaler medication within 28 days of hospital discharge with the main change being the addition of a LABA.

Factors associated with asthma management within 28 days of hospital discharge

In all age cohorts, black ethnic minority groups were the least likely to receive any asthma management within 28 days of hospital discharge (OR 0.62, 95% CI 0.45-0.86 for children; 0.46, 0.29-0.73 for adolescents; and 0.73, 0.60-0.89 for adults) (supplementary table 8).

Obese adolescents were less likely than those of normal weight to receive asthma management within 28 days of hospital discharge (OR 0.60, 95% CI 0.40-0.90). By contrast, obese adults had greater odds of receiving asthma management within 28 days of hospital discharge than patients of normal weight (OR 1.13, 95% CI 1.02-1.25).

Among adults, patients aged 25 years and older had an increased odds of receiving asthma management within 28 days of hospital discharge, compared to those aged 18-24 years. This was most pronounced for patients aged 60-79 years who had an 82% increase in the odds of receiving asthma care 28 days after hospital discharge (OR 1.82, 95% CI 1.56-2.12).

Children who had received SABA and LTRA prescriptions in the previous year were more likely to receive asthma management within 28 days of hospital discharge than those who had not received prescriptions in the previous year. Those who had received 1 to 3 SABA prescriptions in the previous year had almost a 3-fold increase in the odds of receiving asthma care following hospital discharge (OR 2.77, 95% CI 2.00-3.84) while those who had received ≥7 prescriptions in the previous year had a more than six-fold increase in the odds (OR 6.44, 95% CI 4.29-9.64) (supplementary table 8). A similar dose-response trend for SABAs was also found for adolescents and adults. In adults, positive associations were also found for previous prescriptions of OCS, ICS, LTRA, and influenza vaccine.

Discussion

Summary

Our analysis of 17,455 asthma patients revealed that a substantial proportion did not receive timely post-hospitalisation asthma management in primary care. 85% of patients had not received primary care-based asthma management within 48 hours of hospital discharge, and 40% had not within 28 days, including an asthma review, asthma management plan, relevant prescriptions, demonstration of inhaler technique, or smoking cessation support. Patients from black ethnic minority groups were the least likely to receive any post-hospitalisation asthma care. Care was also less likely to be received by obese adolescents, and younger adults. Patients who had received asthma medication prescriptions in the previous year were more likely to receive post-hospitalisation care in primary care.

Comparison with existing literature

Multiple studies have evaluated asthma management in UK primary care.(17),(18),(19) To our knowledge, this study is the first to evaluate post-hospitalisation asthma management in a large UK primary care population.

Although evidence suggests comprehensive post-hospitalisation asthma care minimises adverse asthma outcomes,(20),(21) we found that the practice of such care was significantly below existing standards and guidelines.(7),(10) We found that more than 85% of asthma patients failed to receive follow-up asthma care within the recommended 48 hours of hospital discharge(7),(10) which is consistent with previous evidence.(22),(23) The UK National Review of Asthma Deaths reported that only 23% of asthma patients who had died had ever received an asthma management plan from primary or secondary care.(20) In a survey of Scottish patients who had asthma attacks requiring oral corticosteroids or hospitalisation within the previous six months, only 4% reported receiving a written asthma action plan from primary care.(24)

Ethnic disparities in the provision of asthma care have been reported by several previous studies,(18),(25) which is also a significant finding in our study, particularly among black ethnic groups. Previous literature suggests that this disparity is due to differences in health-seeking behaviour,(26) and less familiarity with primary healthcare services(27) among these population groups. Given that these population groups exhibit much higher asthma-related hospitalisations and ED visits,(25),(28) these disparities need urgent intervention. Hospital teams should address essential asthma care and make changes to medications before discharging patients. GPs, practice nurses and school nurses should use every opportunity to educate, review and change asthma management to prevent future asthma attacks.

Socioeconomically deprived asthma patients tend to have relatively poor asthma outcomes,(18),(9),(29),(30) however, receiving post-hospitalisation asthma care was not significantly associated with socioeconomic deprivation in our study. A previous UK study also reported no variation in receiving asthma reviews or asthma referrals by the socioeconomic status of patients.(18) By contrast, Alsallakh et al reported that the most socioeconomically deprived asthma patients in Wales had lower levels of asthma-related primary care consultations and prescribing although they did not specifically describe post-hospitalisation asthma management.(31) Further research is needed to assess post-hospitalisation asthma management in primary care across socioeconomic strata in other populations to assess the consistency of our findings.

Despite evidence indicating that obesity is associated with an increased risk of asthma-related hospitalisations and readmissions,(32) ,(33),(34) we found that obese adolescents were less likely to receive post-hospitalisation asthma care compared to non-obese adolescents. This runs counter to previous literature that suggests that both elective and emergency healthcare utilisation is higher in children with obesity including those with asthma.(35) It is unclear whether our findings were due to chance as the sample size of obese adolescents in our study was relatively small (n=139), and future studies should look to assess whether this is a consistent finding in other populations.

A study from the USA evaluating outpatient follow-up care after an adult ED asthma visit reported that patients aged 45 years and older were more likely to receive follow-up care within 30 days of an ED visit.(22) We observed a similar increased likelihood for older adults to receive post-hospitalisation asthma care compared to younger adults.

Strengths and limitations

The large sample size allowed us to stratify the analysis by three age groups including children, adolescents, and adults. This enabled us to identify disparities in post-hospitalisation asthma care in each age group and the risk factors associated with differences in post-hospitalisation primary care management.

Asthma was defined by the presence of prespecified SNOMED-CT codes in primary care records. Asthma is a clinical diagnosis which can often be misdiagnosed in primary care.(36),(37) Asthma-related hospitalisation could be misclassified as there may be overlapping symptoms of exacerbations due to other comorbidities. This misclassification bias was minimised by excluding asthma patients with other chronic respiratory diseases such as COPD, bronchiectasis, and ILD.

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A significant proportion of hospital attendances with asthma attacks are made to the emergency department, which we did not have data for in our study except for patients who were admitted. Our assessment of clinical management was also limited to using clinical codes corresponding to asthma management, which would not incorporate aspects of care that were documented through free text entries in primary care records. This may have resulted in an underestimate of post-hospitalisation asthma care; however, we expect most asthma care to be well coded as asthma is part of the Quality and Outcomes Framework in England, a payment incentive programme rewarding appropriate reporting and management of specific chronic conditions; any underestimate is therefore likely to be small. A further limitation was a lack of data on asthma care delivered prior to hospital discharge. This information may be included in discharge letters to primary care and influence the necessity of rapid follow-up, which we were unable to adjust for. Future work could address this limitation by linking data from the national asthma audit, which collects data on hospital care.

We were able to explore a range of patient characteristics in our analysis, however, it is likely that there are additional factors which may be associated with post-hospitalisation asthma care which we did not explore, for instance practice-level characteristics including rural/urban location and practice size, and additional patient-level characteristics such as multimorbidity and frailty. Despite adjusting for several potential confounders, due to the cohort study design, it is possible that some results may be affected by residual confounding.

Our study follow-up ended in 2019. Future studies should explore the impact of changes in healthcare delivery during and after the COVID-19 pandemic on post-hospitalisation asthma reviews. The impact of telephone-based asthma reviews in particular needs to be evaluated as essential asthma care assessment, including checking inhaler technique and whether inhalers are empty(38) cannot be adequately performed via a telephone review.

Implications for practice, policy, and research

Our study provides valuable insights into the state of post-hospitalisation primary care-based asthma management in England. The study identified significant shortfalls in implementing recommendations for primary care from the national asthma guideline(39) and National Review of Asthma Deaths,(40) particularly for black ethnic minority groups. Improved communication, data sharing, and integrated clinical pathways are needed between secondary and primary care services so that hospitalised patients with asthma are followed up appropriately in primary care and receive timely interventions.

GPs and practice nurses should receive a clinical handover from secondary care within 24 hours of an asthma patient being discharged from hospital.This information should ideally be structured, containing reconciled discharge information,(41) and be aligned with national standards for discharge summaries.(42) Critically, this should include a summary of the hospital admission, including disease severity and treatments given; relevant findings from clinical investigations; reconciled medications and changes to asthma treatment; patient and carer concerns, expectations and wishes; information and advice given; an updated asthma management plan; and specific actions for the primary care team.(42)This would facilitate the timely review of these patients in the community to help prevent further exacerbations and improve continuity of care.(43) This will be particularly important in high-risk patients such as those from black ethnic minority groups who experience significant health inequalities.

Patients and their caregivers should also be empowered to actively contact primary care services when they are discharged from hospital to ensure they receive timely care. The impact of these service changes could be evaluated by repeating this study in future cohorts and incorporating data on ED attendance.

Conclusion

There are significant shortfalls and inequalities in post-hospitalisation asthma care in general practice in England. Robust systems are needed to ensure the timely follow-up of post-hospitalised asthma patients in primary care, which includes timely handover from secondary care.

Tables

Table 1 – Baseline characteristics

Characteristic	Children (n=2,512)	Adolescents (n=1,511)	Adults (n=13,434)
Age (years), median (IQR)	8.9 (7.5-10.3)	14.5 (13.2-16.0)	48.9 (33.9-63.9)
Female sex, n (%)	893 (35.6)	747 (49.4)	9,624 (71.6)
Ethnicity			
White	1,323 (52.7)	717 (47.5)	8,893 (66.2)
Black	215 (8.6)	105 (7.0)	556 (4.1)
Mixed	136 (5.4)	79 (5.2)	265 (2.0)
Asian	403 (16.0)	200 (13.2)	1,375 (10.2)
Other	57 (2.3)	53 (1.5)	167 (1.2)
Missing	378 (15.1)	387 (25.6)	2,178 (16.2)
Index of multiple deprivation score, n (%)			
1 – Least deprived	369 (14.7)	210 (13.9)	2,044 (15.2)
2	355 (14.1)	208 (13.8)	2,207 (16.4)
3	400 (15.9)	263 (17.4)	2,435 (18.1)
4	555 (22.1)	336 (22.2)	3,059 (22.8)
5 – Most deprived	831 (33.1)	494 (32.7)	3,681 (27.4)
Missing	2 (0.1)	0 (0)	8 (0.1)
Body mass index, n (%)			
Underweight	186 (7.4)	203 (13.4)	299 (2.2)
Normal weight	1,008 (40.1)	633 (41.9)	3,172 (23.6)
Overweight	245 (9.8)	215 (14.2)	3,587 (26.7)
Obese	122 (4.9)	139 (9.2)	5,593 (41.6)
Missing	951 (37.9)	321 (21.2)	783 (5.8)
Smoking status, n (%)			
Current smoker	-	176 (11.7)	4,093 (30.5)
Former smoker	-	193 (12.8)	5,296 (39.4)
Never smoked	-	921 (61.0)	3,818 (28.4)
Missing	-	221 (14.6)	227 (1.7)
Comorbidities, n (%)			
Allergies	714 (28.4)	605 (40.0)	4,505 (33.5)
Atopic eczema	1,392 (55.4)	871 (57.6)	4,205 (31.3)
Allergic rhinitis	529 (21.1)	569 (37.7)	4,344 (32.3)
Gastro-oesophageal reflux disease (GORD)	162 (6.5)	76 (5.0)	2,328 (17.3)
Chronic rhinosinusitis	0 (0)	3 (0.2)	425 (3.2)
Anxiety	20 (0.8)	104 (6.9)	4,407 (32.8)
Depression	22 (0.9)	59 (3.9)	6,432 (47.9)
Medication use within previous year, n (%)			
Short acting beta 2 agonist (SABA)			
0	323 (12.9)	227 (15.0)	3,022 (22.5)
1-3	1,055 (42.0)	488 (32.3)	4,213 (31.4)
4-6	604 (24.0)	316 (20.9)	2,530 (18.8)
≥7	530 (21.1)	480 (31.8)	3,669 (27.3)
Oral corticosteroid	990 (39.4)	565 (37.4)	7,018 (52.2)
Inhaled corticosteroid	1,973 (78.5)	1,193 (79.0)	10,382 (77.3)
Long-acting beta 2 agonist (LABA)	55 (2.2)	78 (5.2)	2,760 (20.5)
Long-acting muscarinic antagonist (LAMA)	0 (0)	7 (0.5)	1,206 (9.0)
Leukotriene receptor antagonist (LTRA)	804 (32.0)	482 (31.9)	2,608 (19.4)
Influenza vaccine	1,025 (40.8)	564 (37.3)	6,920 (51.5)
Number of hospital admissions, n (%)			

Characteristic	Children (n=2,512)	Adolescents (n=1,511)	Adults (n=13,434)
0	2,254 (89.7)	1,385 (91.7)	12,865 (95.8)
1-3	237 (9.4)	98 (6.5)	469 (3.5)
4-6	14 (0.6)	7 (0.5)	41 (0.3)
7+	7 (0.3)	21 (1.4)	59 (0.4)

Table 2 – Post-hospitalisation asthma management received in primary care

Asthma management n (%)	Children (n=2,512)			Adolescents (n=1,511)			Adults (n=13,434)		
	Timeframe within:			*Timeframe within:*			*Timeframe within:*		
	48 hrs	*7 days*	*28 days*	*48 hrs*	*7 days*	*28 days*	*48 hrs*	*7 days*	*28 days*
Any asthma management, n (%) *	453 (18.0)	834 (33.2)	1473 (58.6)	270 (17.9)	483 (32.0)	880 (58.2)	1,862 (14.0)	4,262 (31.7)	8,162 (60.8)
Asthma management plan *	34 (1.3)	94 (3.7)	257 (10.2)	20 (1.3)	57 (3.8)	156 (10.3)	122 (0.9)	375 (2.8)	1,046 (7.8)
Asthma review *	59 (2.3)	145 (5.8)	391 (15.6)	31 (2.0)	85 (5.6)	222 (14.7)	199 (1.5)	590 (4.4)	1,698 (12.6)
Inhaler technique *	20 (0.8)	66 (2.6)	227 (9.0)	11 (0.7)	43(2.8)	138 (9.1)	99 (0.7)	343 (2.5)	1,135 (8.4)
Smoking cessation ‡	N/A**	N/A	N/A	0 (0)	3 (1.7)	3 (1.7)	15 (0.4)	29 (0.7)	49 (1.2)
Any medication, n (%) *	426 (16.9)	779 (31.0)	1,391 (55.4)	251 (16.6)	447 (29.6)	828 (54.8)	1,713 (12.7)	3,943 (29.3)	7,777 (57.9)
SABA *	298 (11.9)	570 (22.7)	1,073 (42.7)	180 (11.9)	327 (21.6)	670 (44.3)	212 (1.6)	2,137 (15.9)	5,127 (38.2)
ICS *	219 (8.7)	423 (16.8)	927 (36.9)	147 (9.7)	276 (18.3)	603 (39.9)	925 (6.9)	2,251 (16.7)	5,848 (43.5)
OCS *	110 (4.4)	171 (6.8)	267 (10.6)	65 (4.3)	106 (7.0)	169 (11.2)	551 (4.1)	1,408 (10.5)	2,551 (19.0)
LAMA *	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.1)	5 (0.3)	85 (0.6)	247 (1.8)	799 (5.9)
LABA *	5 (0.2)	9 (0.3)	18 (0.7)	9 (0.6)	16 (1.0)	43 (2.8)	253 (1.9)	676 (5.0)	1,908 (14.2)
LTRA *	83 (3.3)	172 (6.8)	435 (17.3)	32 (2.1)	69 (4.6)	220 (14.5)	209 (1.5)	578 (4.3)	1,656 (12.3)

*Denominator is total number of patients in each age-group

**N/A – not applicable as smoking status was unavailable for this age group

‡ Denominator is number of patients who are current smokers in that age group

 SABA- short acting beta 2 agonist,ICS- inhaled corticosteroid, OCS- oral corticosteroid, LAMA- long-acting muscarinic antagonist, LABA- long-acting beta 2 agonist, LTRA- leukotriene receptor antagonist
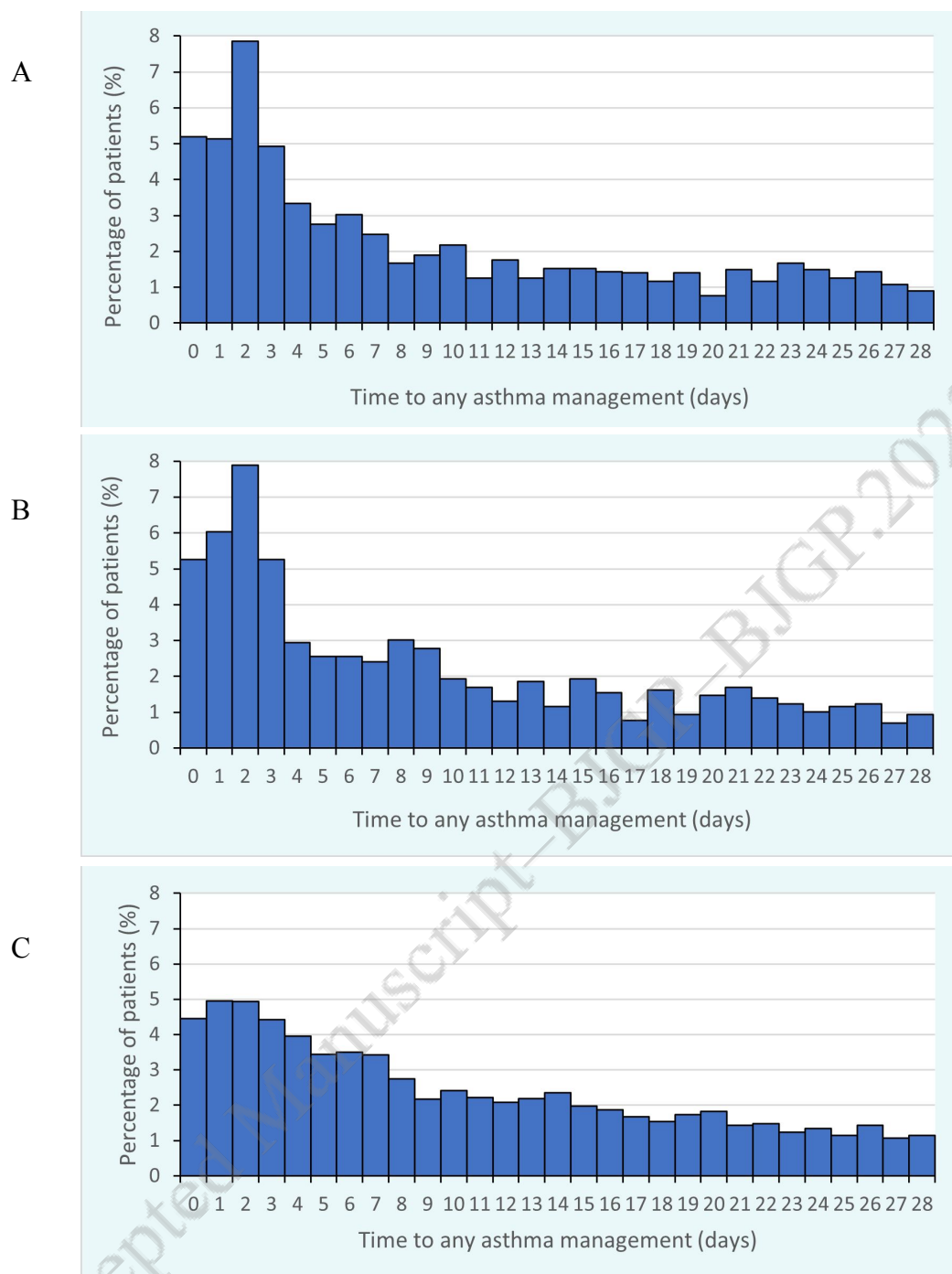
Figure 1. Percentage of patients receiving any post-hospitalisation asthma management in primary care from the time of hospital discharge in children (A), adolescents (B), and adults (C)

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