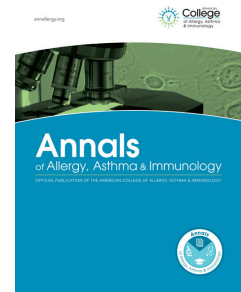


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Pediatric asthma affects 8 million U.S. children and approximately 50% experience an acute asthma exacerbation each year.^{1,2} Despite national guidelines recommending daily anti-inflammatory or controller medication to treat persistent and uncontrolled asthma,³ most inner-city children with persistent asthma do not receive guideline-based therapy.⁴ Understanding factors associated with underuse of controller medication may inform clinical interventions to improve asthma control in these high risk children. We examined sociodemographic and health factors associated with timing of controller medication fills in children with frequent asthma emergency department (ED) visits.

Children and their caregivers (cohort n=222) were recruited and enrolled in a randomized controlled trial testing the efficacy of an ED/home-based environmental control intervention.⁵ Enrollment occurred during an asthma ED visit and children were followed for 12 months. Number of days to controller medication fill post ED visit was the primary outcome. The study was approved by the medical center institutional review board and written informed consent was obtained from the child's caregiver/legal guardian. Inclusion criteria were physician diagnosed persistent and uncontrolled asthma, ≥ 2 or more asthma ED visits or ≥ 1 hospitalizations/past 12 months.⁵ Asthma severity and control, using NAEPP guideline criteria,³ were based on caregiver report of symptom days/14 days and nights/30 nights, frequency of short-acting beta agonist use, child activity of limitation, number of oral corticosteroid courses/past 12 months and number of asthma ED and hospitalizations/past 12 months. Pharmacy records provided data for all asthma medications filled prior to enrollment and over the follow-up and included dispensing date, product name, strength, dosage, and quantity dispensed. Healthcare utilization data (number of ICU asthma admissions, asthma primary and /or specialty care and ED visits or hospitalizations, type of health insurance) was extracted from electronic medical records. Sociodemographic

characteristics and caregiver beliefs about asthma medications (worry about side effects and household sharing of medication) were based on self-report. Serum allergen-specific IgE tests determined atopy status.

Number of days to controller medication fills post index enrollment ED visit were counted. Cox regression analyses then examined factors associated with cumulative probability of filling respective medication (event) with each subsequent day from patient's index ED visit, median days from study enrollment to first fill while controlling for sociodemographic, prior controller fills and health factors. Analyses were conducted using SPSS Version 22 software.⁶

Children were primarily male (65%), African American (94%), insured through Medicaid (95%), had a mean age of 6.3 years (SD 2.7) and categorized with moderate (46%) or severe (29%) persistent asthma. Over one third (37%) had a prior ICU asthma admission. Caregivers were primarily child's biological mother (92%), African American (96%), with a median age of 30 years. Over the 12 month follow-up, half of children had a repeat asthma ED visit and a similar percent (49%) received ≥ 1 PCP preventive asthma visit. Yet, only 21% received asthma specialty care despite underlying uncontrolled asthma and a high atopy rate (82.5%) based on IgE tests. Caregiver worry about medication side effects was moderate (36%) and 18% reported family sharing of child's asthma medications. The median number of days to filling any controller medication was 47 days. There was a 22.5% (95% CI 17.7, 28.5) risk of not filling a controller medication over the 12 months.

Shorter time, e.g. fewer days, to filling controller medication was noted in children seen by an asthma specialist (Specialty Care Yes : 22 days; No: 49 days), prior ICU asthma admission (ICU Yes: 19 days; No: 80 days), older caregiver (40 years or older: 18 days) as compared to younger caregivers (20 years of age: 191 days) and subsequent asthma ED visit (ED visit Yes: 10

days; No: 56 days) (Table 1). Shorter time to controller fill was not associated with type of health insurance, atopy status, caregiver worry about medication side effects, and prior fills of controller medication .

Overall, inner-city children with poorly controlled asthma were more likely to fill a controller medication in < 30 days when they received asthma specialty care or had a history of an ICU asthma admission or had an older caregiver or after a recent ED asthma visit. However, one out of five children did not fill any controller medication post ED visit. Adherence to regular controller medication use is a complex and multidimensional challenge involving child, caregiver and healthcare provider factors including lack of health insurance⁷ non-receipt of asthma specialty care,^{7,8} lack of prescribed guideline-based care, caregiver knowledge and beliefs about asthma treatment and unsupervised controller medication use by providers.

Notably, prior ICU asthma admission was associated with shorter time to controller medication fill. Experiencing a prior ICU asthma admission may result in increased likelihood of providers prescribing and caregiver filling controller medications.⁸ Furthermore, older caregiver age was associated with shorter time to obtaining a controller medication. Perhaps older caregivers have an increased awareness of the seriousness of asthma in young children, which is not appreciated by younger caregivers.⁹

We conclude that healthcare providers should ensure access to controller medication prescriptions during any acute or primary care asthma visit. All children with 2 or more asthma ED visits or hospitalization over 12 months require referral to specialty care per guideline-based therapy and monitoring the frequency of controller and rescue medication fills via pharmacy records or electronic medical record. Last, enhanced asthma education and referral to community support services may be indicated for young caregivers of children with asthma.¹⁰

70 This study has potential limitations. Relying on pharmacy fill data for controller
71 medication fills is not a direct measurement of child controller medication use. Sharing of
72 asthma medications by other family members, receipt of samples, or prior possession of
73 controller medications could result in overestimation of controller medication use by the child.
74 However, the expected effect on study findings should be minimal. Second, generalizability of
75 results is limited due to the purposeful recruitment of children with more severe or uncontrolled
76 asthma. Nonetheless, our results support monitoring the time to controller and rescue medication
77 fills, referral to asthma specialist and support for younger caregivers of children with poorly
78 controlled asthma.

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Table 1. Cox regression results: cumulative probability of patient fills for controller medication by day listed from the enrollment ED visit. Probabilities across time for each respective level and median time to first controller prescription fill were estimated at distribution of four significant covariates in the study population.

Characteristic	Median number of days since enrollment ED visit to controller fill	Hazardous Ratio (95% CI), p value
Seen by Asthma Specialist past 2 years NO YES	49 days 22 days	HR=1.49 (1.03,2.16), p=0.036
Prior asthma ICU Admission (lifetime) NO YES	80 days 19 days	HR=1.83 (1.32,2.52), p<0.001
Maternal Age 20 -29 Years 30-39 Years 40 years and older	191 days 49 days 18 days	HR=1.05 (1.03,1.07), p<0.001
Repeat ED visit post enrollment NO YES	56 days 10 days	HR=2.24 (1.40, 3.50), p=0.001