

Guideline-Informed Care Among Medicaid-Enrolled Children With Food Allergy

Madeleine K. Kanaley, BA; Ashley A. Dyer, MPH; Olivia R. Negris, MA; Jamie L. Fierstein, PhD; Christina E. Ciaccio, MD, MSc; Ruchi S. Gupta, MD, MPH; and Lucy A. Bilaver, PhD

Food allergy (FA), a chronic condition of public health importance, affects 7.6% of US children and is known to impair quality of life.¹⁻³ Current guidelines for FA diagnosis and management recommend that all children with suspected FA visit an allergist for confirmatory testing and also receive a prescription for epinephrine autoinjectors (EAI).^{4,5} Previous guideline-related research among pediatricians has demonstrated high rates of allergy referral for children with FA (67%) but low rates of EAI prescription fills (44.9%).⁶ Other research has focused on FA-related health care utilization after emergency department (ED) visits for conditions such as food-induced anaphylaxis. One study showed that among children with FA who visited the ED for food-induced anaphylaxis, 83% filled an EAI prescription but only 43% followed up with an allergist within 1 year.⁷

Barriers present in the US health care system may prevent the appropriate provision of guideline-informed care and may increase the burden for low-income children. For example, studies have shown that children with low socioeconomic status (SES) tend to have low rates of physician-confirmed FA, often self-diagnosing their FA and avoiding foods based on symptoms and previous reactions.⁸ Additional research has shown that those in the lowest SES stratum utilize the ED for FA-related care more than 2.5 times as often as those in the highest SES stratum, potentially missing the opportunity for formal physician diagnosis.⁹ The lack of clinical diagnosis among low-SES families can affect access to guideline-informed care such as confirmatory testing, proper medication, and educational resources for effective FA management. In addition, low-SES families often have trouble accessing allergen-free foods, EAIs, and other FA-related medical necessities.¹⁰⁻¹⁴

Although patterns of socioeconomic disparities in guideline-informed care among children with FA are emerging within the literature, less is known about children enrolled in the Medicaid program, the single largest health insurer of socioeconomically disadvantaged children in the United States. Studies on guideline-informed FA care among Medicaid-enrolled children are scarce; to date, there are no established estimates of FA-related health care access among Medicaid-enrolled children. Therefore, the

ABSTRACT

OBJECTIVES: To describe food allergy (FA)-related service utilization and identify factors associated with guideline-informed care among Medicaid-enrolled US children with FA.

STUDY DESIGN: Retrospective cohort study.

METHODS: We used the 2012 Medicaid Analytic eXtract files to identify children with an FA diagnosis. FA-related services including outpatient allergist visits, emergency department (ED) visits, epinephrine autoinjector prescription fills, and diagnostic testing were identified. Factors associated with services were assessed using logistic regression. Kaplan-Meier survival curves evaluated the time to guideline-informed care, and proportional hazard models determined associated socioeconomic characteristics.

RESULTS: There were 64,276 Medicaid-enrolled children younger than 20 years who had at least 1 claim with an FA diagnosis in 2012. Minority children and those living in a high-poverty county were less likely to have visited an allergist for FA or received diagnostic testing but more likely to have an FA-related ED visit compared with White children and those not living in a high-poverty county. Survival analyses found that of children seen for FA-related primary care or an ED visit, rates of allergist follow-up visits were 21% and 17%, respectively, and rates of epinephrine autoinjector prescription fills were 39% and 41%. Significant associations with guideline-informed care were found by race/ethnicity, dense population, and high-poverty counties.

CONCLUSIONS: Although guideline-informed FA care includes follow-up with an allergist and epinephrine autoinjector prescription, this study finds low probabilities of timely service utilization after medical visits, as well as socioeconomic disparities in care.

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TAKEAWAY POINTS

Food allergy (FA) is a chronic condition of public health importance, affecting 7.6% of US children. Current guidelines for FA diagnosis and management recommend that all children with suspected FA visit an allergist and receive a prescription for an epinephrine autoinjector.

- ▶ Previous research shows that receiving this guideline-informed care is challenging among this population, especially in those with low socioeconomic status.
- ▶ This study advances understanding of guideline-informed care and service use among Medicaid-enrolled children with FA. Results demonstrated socioeconomic disparities in access to guideline-informed care among specific segments of the Medicaid population that warrant further study and intervention.

goal of this study was to describe FA-related service utilization and identify factors associated with guideline-informed FA care among Medicaid-enrolled US children.

METHODS

Data

This study analyzed 2012 Medicaid Analytic eXtract (MAX) person-level data, the most recent available for all 50 states and the District of Columbia. We used 4 MAX files: Other Therapy (OT), Inpatient (IP), Personal Summary, and Prescription. We also used data from the National Plan and Provider Enumeration System (NPPES) and Area Health Resources Files (AHRF). The study was approved by the Ann and Robert H. Lurie Children's Hospital of Chicago's Institutional Review Board.

Analytic Sample

The analytic sample included children aged 0 to 19 years as of January 1, 2012, enrolled in Medicaid for all of 2012 with at least 1 FA diagnosis claim. We identified children with immunoglobulin E (IgE)-mediated FA based on the following *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9)* codes¹²⁻¹⁹: 995.60-995.69, 995.7 (anaphylaxis to food), and V15.01-V15.05 (history of FA). As a sensitivity analysis, we used a more liberal definition of FA by including 2 additional codes: 692.5 (topical food dermatitis) and 693.1 (dermatitis due to food). We further limited the sample by excluding children enrolled in Medicare and those without full benefits. We excluded children from Idaho because there were so few with full benefits (n = 56).

Dependent Variables

We created 5 indicators to reflect the receipt of care consistent with diagnosis and management guidelines (visit to an allergy or immunology provider [hereafter, allergist]; skin prick test [SPT]; measurement of specific or total IgE; oral food challenge [OFC]; or filling an EAI prescription). In addition, we created an indicator of suboptimal management (eg, FA-related ED visit). Allergist visits were identified using NPPES data by linking the National Provider Identifier (NPI) and taxonomy code to classification and specialty variables. We identified EAI prescriptions with 25 unique National

Drug Codes, whereas other services were identified by procedure codes selected through literature reviews and clinician consultation.

Independent Variables

We selected 3 independent variables to reflect child SES and location. A 7-level race/ethnicity variable was categorized into non-Hispanic Asian, non-Hispanic Black, Hispanic, non-Hispanic Native American, non-Hispanic Pacific Islander/Native Hawaiian, multiple/unknown/missing race, or non-Hispanic White.

Children from Colorado were missing race/ethnicity information and therefore were excluded from multivariable analyses. We derived a dichotomous county-level urban-rural categorization (metropolitan vs nonmetropolitan) from the geographic variable available in the AHRF. High poverty was indicated by county-level child poverty of 20% or higher.^{20,21}

Control Variables

We controlled for gender (male, female, unknown); age on January 1, 2012 (0-5, 6-11, 12-17, 18-19 years); Medicaid payment plan (some managed care claims vs none); Census region (Northeast, Midwest, South, West); and Medicaid eligibility (disability, foster care, low income, and other/unknown). Atopic comorbidities were derived by identifying OT and IP claims with *ICD-9* diagnosis codes. Specifically, we used 493.xx to identify claims with an asthma diagnosis, 691.8 (other atopic dermatitis) for atopic dermatitis, and 477.0 (rhinitis from pollen), 477.2 (allergic rhinitis from cat/dog), 477.8 (allergic rhinitis not elsewhere classifiable), and 477.9 (allergic rhinitis not otherwise specified) for allergic rhinitis.

Statistical Analysis

We ran univariable analyses to describe sample characteristics and multivariable logistic regression to identify adjusted associations between independent variables and FA services. We performed separate Kaplan-Meier survival analyses in 2 risk groups to estimate the time to an outpatient allergist visit or EAI prescription fill. The first risk group included children seen by a pediatric or family medicine clinician; the second risk group included children who visited the ED. In both groups, we identified the first occurrence of each type of service during 2012 and excluded children who had any prior FA diagnosis claim; Cox proportional hazard models measured the relative risk of each independent variable. All analyses were performed using SAS 9.4 (SAS Institute Inc).

RESULTS

Among 64,276 children with an FA diagnosis, 55% were male, 61% were aged 0 to 5 years, 32% were non-Hispanic White, 30% were non-Hispanic Black, and 20% were Hispanic (**Table 1**). The majority of children were eligible for Medicaid due to low income (81%),

more than half resided in a metropolitan county (89%), and more than half (67%) lived in a high-poverty county.

Figure 1 illustrates that during 2012, 27% of children with an FA diagnosis had at least 1 claim for an FA-related primary care visit, 30% had at least 1 claim for an outpatient allergist visit, and 18% visited the ED with an FA diagnosis. In addition, 47% of children with FA filled an EAI prescription and approximately 46% had some form of diagnostic testing (SPT/IgE/OFC).

Asian children had consistently lower adjusted odds of almost all FA-related services compared with White children (**Table 2**). Asian, Black, and Hispanic children had higher odds of a primary care visit for FA than White children and lower odds of allergist visits and diagnostic testing. Hispanic children had significantly lower odds of allergy visits, EAI prescription fills, SPTs, and OFCs compared with White children. Black children were more likely to visit the ED for FA. Asian, Hispanic, and Native American children had lower odds of EAI prescription fills compared with White children, in contrast to Black children, who were more likely than White children to have an EAI prescription filled (odds ratio [OR], 1.10; 95% CI, 1.05-1.14). Compared with nonmetropolitan county residence, metropolitan county residence was associated with higher odds of an allergist visit, EAI prescription fill, and diagnostic testing. Residence in a high-poverty county was associated with 12% to 28% lower odds of allergist visits, EAI prescription fills, SPT, and OFC; 16% higher odds of a primary care visit for FA; and 23% higher odds of FA-related ED visits.

Figure 2 [A-D] presents Kaplan-Meier survival curves, which measure the probability of guideline-informed care over time with censored data. The probability of seeing an allergist within 180 days of an FA-related pediatric or family practice visit was 21% (**Figure 2 [A]**), whereas the probability of filling an EAI prescription was 39% (**Figure 2 [B]**). **Figure 2 [C and D]** present survival estimates for FA-related ED visits. In this subgroup, the probability of seeing an allergist within 180 days post ED visit was 17%, and the probability of filling an EAI prescription was 41%.

Table 3 presents relative risks of guideline-informed care by socioeconomic characteristics among children after FA-related primary care or ED visits. Among children seen in primary care for FA, Black children had higher relative risk of EAI prescription fill (HR, 1.28; 95% CI, 1.19-1.38). Asian, Black, and Hispanic children had lower relative risk of allergist follow-up compared with White children. Residence in a high-poverty county was associated with 16% lower risk of allergist follow-up (HR, 0.84; 95% CI, 0.77-0.91) and 17% lower risk of EAI prescription fill (HR, 0.83; 95% CI, 0.78-0.89). Among children who had FA-related ED visits, Black children had lower relative risk of allergist follow-up (HR, 0.74; 95% CI, 0.61-0.89) compared with White children but equal risk of EAI prescription fill. Hispanic (HR, 0.77; 95% CI, 0.66-0.89) and Native American (HR, 0.55; 95% CI, 0.32-0.94) children had lower relative risk of EAI prescription fill compared with White children but equal risk of allergist follow-up. Metropolitan county residence was associated with higher relative risk of EAI prescription fill. Children living in

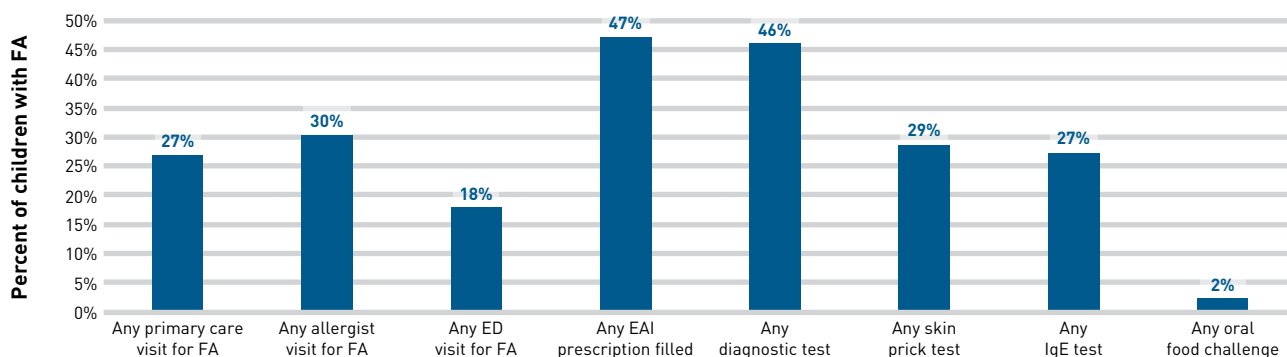
TABLE 1. Characteristics of Children With a Food Allergy Diagnosis Continuously Enrolled in Medicaid Aged 0 to 19 Years in 2012

Variable	n	% of total
Total	64,276	100.0
Gender		
Female	28,767	44.8
Male	35,505	55.2
Unknown	NR	NR
Age in years		
0-5	38,942	60.6
6-11	15,375	23.9
12-17	8810	13.7
18-19	1149	1.8
Comorbidities (atopic march)		
Atopic dermatitis	12,804	19.9
Allergic rhinitis	23,061	35.9
Asthma	23,618	36.7
Medicaid payment plan type		
Some managed care claims	59,218	92.1
Only fee-for-service claims	5058	7.9
Region		
Northeast	15,517	24.1
Midwest	14,082	21.9
South	23,157	36.0
West	11,520	17.9
Category of eligibility		
Disability	4914	7.7
Foster care	1608	2.5
Other	5416	8.4
Low income	52,338	81.4
Race/ethnicity		
Asian, non-Hispanic	2214	3.4
Black, non-Hispanic	19,142	29.8
Hispanic	13,050	20.3
Native American	709	1.1
Pacific Islander/Native Hawaiian	381	0.6
Multiracial or unknown or missing	8088	12.6
White, non-Hispanic	20,692	32.2
Metropolitan county category		
Metropolitan county	57,091	88.8
Nonmetropolitan county	7185	11.2
Living in a county with high poverty (≥20%)		
Yes	43,252	67.3
No	21,024	32.7

NR, not reported due to cell size less than 10.

high-poverty counties had both lower risk of allergist follow-up (HR, 0.73; 95% CI, 0.62-0.86) and lower risk of EAI prescription fill (HR, 0.89; 95% CI, 0.80-0.99) compared with those living in low-poverty counties.

FIGURE 1. Percentage With FA-Related Service Among Children With an FA Diagnosis Continuously Enrolled in Medicaid in 2012



EAI, epinephrine autoinjector; ED, emergency department; FA, food allergy; IgE, immunoglobulin E.

TABLE 2. Adjusted ORs From Logistic Regression of Service Use During 2012 Among Medicaid-Enrolled Children With FA (N = 64,276)^a

Variable	Primary care visit for FA OR (95% CI)	Allergist visit for FA OR (95% CI)	ED visit for FA OR (95% CI)	Epinephrine autoinjector prescription fill OR (95% CI)	Diagnostic testing OR (95% CI)	Skin prick test OR (95% CI)	IgE test OR (95% CI)	Oral food challenge OR (95% CI)
Race/ethnicity								
Asian, non-Hispanic	1.44 (1.31-1.58)	0.61 (0.55-0.67)	0.82 (0.71-0.94)	0.88 (0.80-0.96)	0.62 (0.57-0.69)	0.52 (0.47-0.58)	0.87 (0.79-0.96)	0.56 (0.41-0.78)
Black, non-Hispanic	1.11 (1.05-1.16)	0.65 (0.63-0.69)	1.59 (1.51-1.68)	1.10 (1.05-1.14)	0.55 (0.52-0.57)	0.57 (0.55-0.60)	0.67 (0.63-0.70)	0.47 (0.41-0.54)
Hispanic	1.32 (1.25-1.38)	0.65 (0.62-0.69)	1.01 (0.95-1.08)	0.86 (0.82-0.91)	0.76 (0.72-0.80)	0.60 (0.57-0.64)	1.03 (0.98-1.08)	0.72 (0.62-0.83)
Native American	1.02 (0.86-1.22)	0.74 (0.62-0.88)	0.92 (0.73-1.15)	0.73 (0.62-0.86)	0.62 (0.53-0.73)	0.77 (0.64-0.92)	0.63 (0.52-0.76)	0.46 (0.23-0.93)
Pacific Islander/ Native Hawaiian	1.03 (0.82-1.31)	0.53 (0.41-0.68)	1.17 (0.86-1.60)	1.14 (0.92-1.41)	0.72 (0.58-0.89)	0.45 (0.35-0.58)	1.06 (0.84-1.34)	0.44 (0.16-1.20)
Unknown/missing/ multiracial	1.10 (1.03-1.17)	0.82 (0.77-0.87)	1.33 (1.23-1.43)	1.17 (1.11-1.24)	0.82 (0.77-0.87)	0.83 (0.78-0.89)	0.90 (0.84-0.95)	0.71 (0.59-0.84)
White, non-Hispanic	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Metropolitan county designation								
Metropolitan county	0.96 (0.90-1.02)	1.22 (1.15-1.30)	0.94 (0.88-1.00)	1.21 (1.15-1.28)	1.13 (1.07-1.20)	1.09 (1.03-1.16)	1.12 (1.05-1.19)	1.12 (0.94-1.34)
Nonmetropolitan county	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Living in a county with high poverty (≥20%)								
Yes	1.16 (1.12-1.21)	0.79 (0.76-0.82)	1.23 (1.17-1.29)	0.82 (0.80-0.85)	0.88 (0.85-0.91)	0.80 (0.77-0.83)	1.01 (0.97-1.05)	0.72 (0.65-0.81)
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference

ED, emergency department; FA, food allergy; IgE, immunoglobulin E; OR, odds ratio.

^aORs are adjusted by gender, age, comorbidities, payment plan type, region, and category of eligibility. Bolded numbers are significant at $P < .05$. High poverty is defined as having county-level poverty of 20% or higher.

Sensitivity Analysis

When ICD-9 codes 692.5 and 693.1 were included in the selection criterion for the analytic sample, we found 117,514 children with an FA diagnosis. The percentage of children with at least 1 claim for

an FA-related service during 2012 was very similar to that seen in the primary study sample (see the [eAppendix Figure](#) [available at [ajmc.com](#)]). In addition, there were no substantive differences in the multivariate or survival analyses (results not shown).

DISCUSSION

This study measured utilization of FA-related services and guideline-informed care among Medicaid-enrolled children with FA in 2012. We found that compared with White children and those residing in low-poverty counties, minority children and those residing in high-poverty counties were less likely to have visited an allergist or received FA diagnostic testing and more likely to have had an FA-related ED visit. Within 6 months of an FA-related primary care visit, 21% and 39% had guideline-informed allergist follow-ups and EAI prescription fills, respectively. Among children with an FA-related ED visit, we found that 17% and 41% had an allergist follow-up and EAI prescription fill, respectively. Socioeconomic differences in utilization of guideline-informed care were apparent.

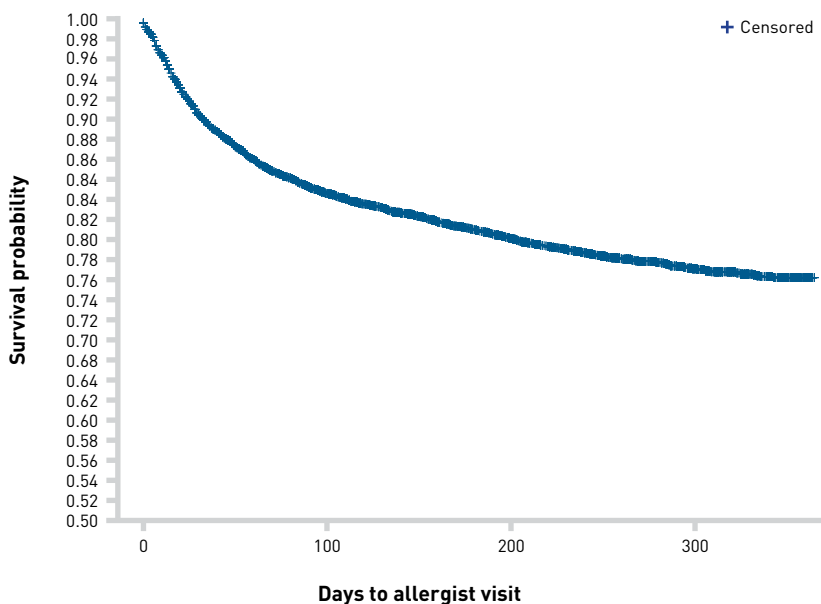
These findings indicate that access to guideline-informed care remains challenging despite Medicaid eligibility expansions under the Affordable Care Act.¹⁵ Reported barriers to access include the limited number of specialists within Medicaid managed care networks, unavailability of appointments designated for Medicaid patients, and administrative bureaucracy.^{16,17} In the current study, only 30% of Medicaid-enrolled children with FA saw an allergist, with lower odds of allergy visits and related diagnostic tests (SPT and OFC) among minority children and children living in high-poverty counties. On the other hand, previous research by Gupta et al estimated that among a predominately privately insured sample of children, 70% had a documented referral to an allergist, and wait time between pediatrician referral and allergist visit was 4 months.⁶ In another study evaluating 1370 commercially insured adults who experienced food-induced anaphylaxis, more than half filled an EAI prescription post ED discharge, yet only 22% had an allergist visit within 1 year.¹⁸ Clearly, there are disparities in access to guideline-informed care by insurance status for both referrals and follow-up allergy visits.

The current findings suggest that initial point of contact within the health care system was associated with differences in the probability of follow-up to allergy care. For example, we found that among children seen initially by a primary care clinician for FA, 21% had an allergist follow-up within 6 months. Furthermore, children

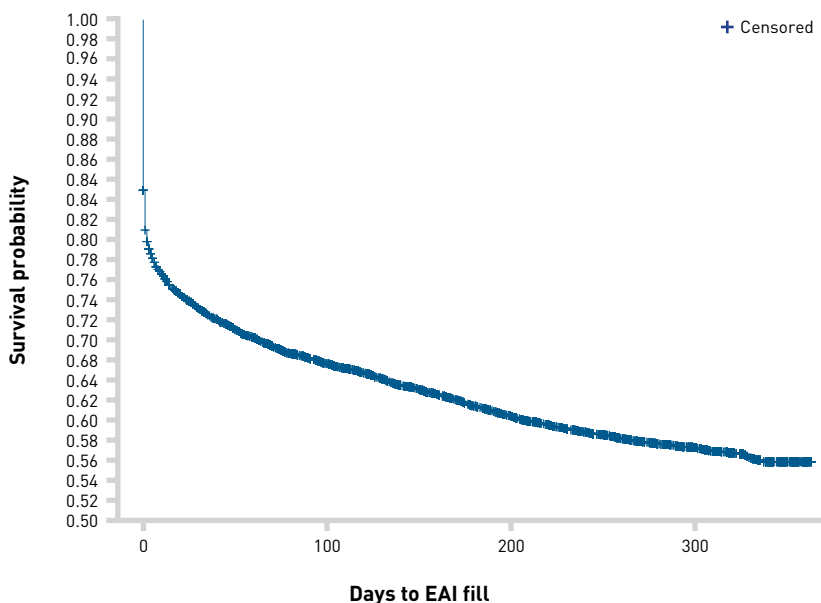
whose initial point of contact was an ED clinician had slightly lower probability (17%) of following up with allergists. For Medicaid-enrolled children with FA, the addition of time-bound indicators to the Children's Health Insurance Program Reauthorization Act Pediatric Quality Measures Program (eg, patients with FA should

FIGURE 2. Kaplan-Meier Estimates of Time to Guideline-Informed FA Care

A. Kaplan-Meier estimates of time to allergist visit after pediatrician or family medicine visit for FA



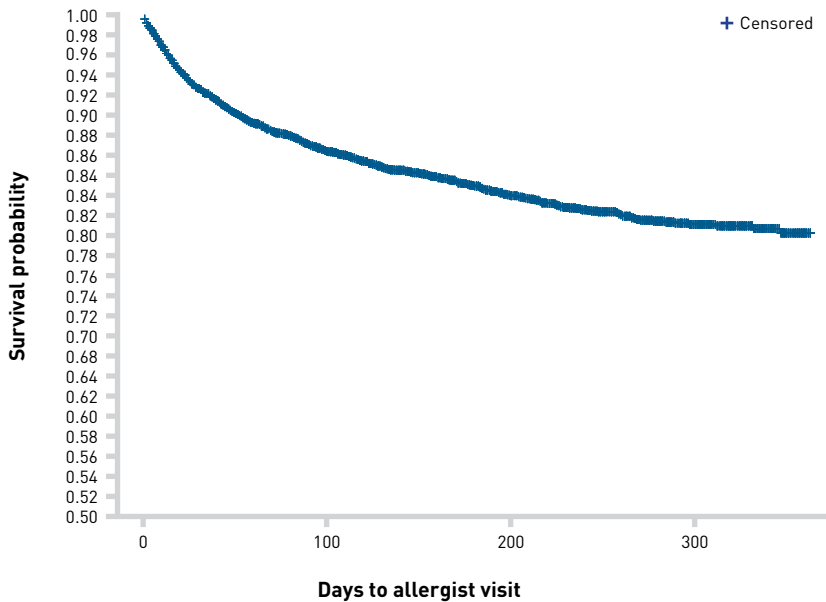
B. Kaplan-Meier estimates of time to EAI prescription fill after pediatrician or family medicine visit for FA



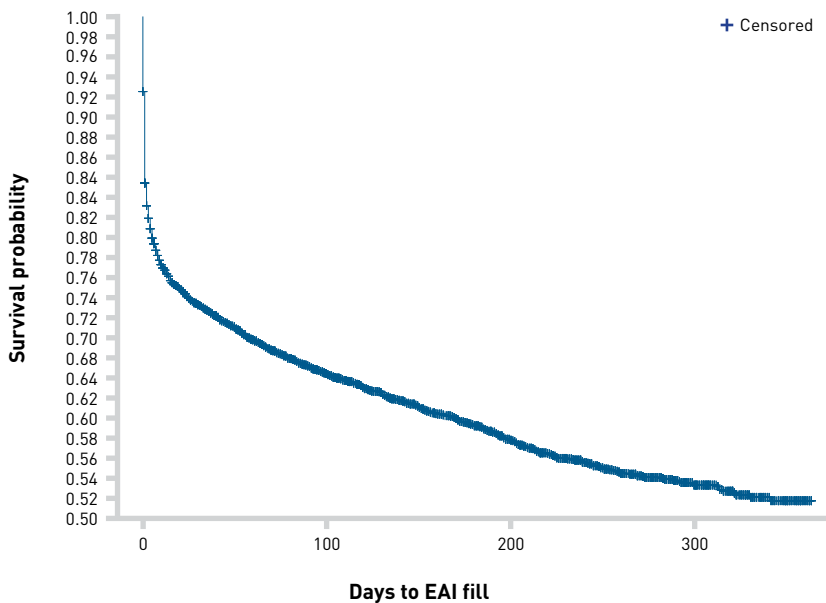
(continued)

FIGURE 2. (Continued) Kaplan-Meier Estimates of Time to Guideline-Informed FA Care

C. Kaplan-Meier estimates of time to allergist visit after ED visit for FA



D. Kaplan-Meier estimates of time to EAI prescription fill after ED visit for FA



EAI, epinephrine autoinjector; ED, emergency department; FA, food allergy.

visit an allergist within 30 days of diagnosis) may provide incentive to facilitate population-level practice shifts. In addition to the development of process- and outcome-oriented quality measures in FA care, further research is needed to incorporate the perspectives of patients regarding needed care.^{15,19}

tion fills and SPT and IgE testing. Physician shortages in rural, nonmetropolitan counties may account for the increased reliance on the ED for FA emergencies, given that one-fifth of the population lives in rural America but only 10% of physicians practice in these areas.²⁶ This may also contribute to lower prescription fill rates and

Regardless of initial point of contact, the majority of Medicaid-enrolled children with an FA diagnosis are not receiving timely guideline-informed care, which may contribute to delays in filling EAI prescriptions and incomplete counseling on accidental food ingestions and other FA-related emergencies. Although an EAI prescription is vital to FA management, we found that only 47% of children with FA had an EAI prescription filled in 2012. Moreover, the likelihood of filling an EAI prescription was significantly lower in Asian, Hispanic, and Native American children; those living outside metropolitan areas; and those living in high-poverty counties. Similar disparities were found in a 2011 study showing that children from higher-SES families were 8.5 times more likely to be prescribed EAI than those from lower-SES homes.¹⁴ Another cross-sectional study found that of 86 Medicaid patients presenting to 2 EDs with anaphylaxis, 31 did not receive a postdischarge EAI prescription.²² Further work is needed to explore these disparities and ensure that clinicians are consistently prescribing EAI to all patient groups for food-induced anaphylaxis.

The current study contributes to the scarce literature on socioeconomic differences in FA-related service use among publicly insured children. Previous research in Illinois over a 5-year period described a 30.2% increase in food-induced anaphylaxis and ED visits among children with public insurance.²³ A 2016 study further demonstrated increased FA-related ED utilization among Black and Hispanic children, of whom 49% were enrolled in Medicaid.¹¹ These noted increases in FA-related ED utilization warrant further exploration of disparities in guideline-informed primary and allergy care.

Geographic differences present unique challenges for the Medicaid population. Rural residents tend to have lower SES compared with residents of other communities.²⁴ Previous research has shown that FA prevalence varies with population density.²⁵ In our analyses, we found that living in a metropolitan county was associated with higher odds of EAI prescription

TABLE 3. HRs From Cox Proportional Hazard Models for Having an Allergist Visit and Filling an Epinephrine Autoinjector Prescription Among Children With an FA Diagnosis Enrolled in Medicaid*

Variable	Children with pediatrician or family medicine visit for FA		Children with ED visit for FA	
	HR (95% CI) of allergist visit for food allergy (n = 12,793)	HR (95% CI) of epinephrine autoinjector prescription filled (n = 12,793)	HR (95% CI) of allergist visit for food allergy (n = 4417)	HR (95% CI) of epinephrine autoinjector prescription filled (n = 4417)
Race/ethnicity				
Asian, non-Hispanic	0.65 (0.52-0.82)	1.00 (0.86-1.16)	1.20 (0.78-1.85)	0.80 (0.58-1.10)
Black, non-Hispanic	0.83 (0.75-0.92)	1.28 (1.19-1.38)	0.74 (0.61-0.89)	0.89 (0.79-1.00)
Hispanic	0.74 (0.66-0.83)	0.99 (0.91-1.07)	0.99 (0.80-1.23)	0.77 (0.66-0.89)
Pacific Islander/Native Hawaiian/Native American	0.82 (0.59-1.14)	1.06 (0.85-1.33)	1.00 (0.47-2.14)	0.55 (0.32-0.94)
Unknown/missing/multiracial	1.05 (0.92-1.19)	1.10 (1.00-1.22)	1.03 (0.78-1.35)	1.08 (0.90-1.28)
White, non-Hispanic	Reference	Reference	Reference	Reference
Metropolitan county designation				
Metropolitan county	1.24 (1.08-1.42)	1.13 (1.03-1.25)	1.14 (0.88-1.49)	1.21 (1.02-1.44)
Nonmetropolitan county	Reference	Reference	Reference	Reference
Living in a county with high poverty (≥20%)				
Yes	0.84 (0.77-0.91)	0.83 (0.78-0.89)	0.73 (0.62-0.86)	0.89 (0.80-0.99)
No	Reference	Reference	Reference	Reference

ED, emergency department; FA, food allergy.

*Children at risk for guideline-informed care are those visiting primary care or the ED for FA. HRs are adjusted by gender, age, comorbidities, payment plan type, region, and category of eligibility. High poverty is defined as having county-level poverty of 20% or higher. Bolded numbers are significant at $P < .05$.

specialty testing. Emerging technology such as telemedicine offers promising solutions to geographical disparities by increasing access to specialty care at lower costs.²⁴ Additionally, previous work has shown that patients with access to specialist care via telemedicine are more likely to receive guideline-informed care.^{24,27} This is a promising solution to providing more timely access and appropriate care among the many patients in the Medicaid population, and more research is needed to determine if telemedicine is a reliable and sustainable solution among this population to address the observed geographical disparities.

Limitations

There are several limitations to this study. The release of the Medicaid data is often delayed by states and, as a result, 2012 is the most recent year available for all 50 states and the District of Columbia. Because we relied on ICD-9 diagnosis codes to identify the population of children with FA, coding nuances including miscoding or lack of coding may affect the composition of the analytic sample. This is particularly true for most ED visits, where the identification of a principal (primary) diagnosis is not possible on outpatient claims. We were left to assume that FA in either the first or second diagnosis code indicated the reason for the ED visit. In the general pediatric population in the United States, 7.6% of children have a convincing food allergy based on stringent criteria, and 4.7% have a physician-confirmed diagnosis. Although the prevalence of FA in the pediatric Medicaid population is much lower than estimates based

on physician-confirmed FA in the general US pediatric population (0.6% in Medicaid vs 4.7% physician-confirmed FA),^{1,28} the range of prevalence estimates among children in the Medicaid program by state is narrow (0.2% in Nevada to 1.4% in Alaska). As a result, we see no evidence that coding practices vary by socioeconomic and geographic characteristics central to this study.

Another limitation is the use of procedure codes and NPIs to identify services and types of providers. Given that coding practices may vary by state, it is possible that we have underestimated FA-related health service claims. Similarly, because not all OT claims had NPIs linked to NPPES data, we may have underestimated the number of children visiting allergists or being seen by pediatricians or family medicine clinicians. However, we found no evidence that these claims were associated with the primary independent variables. Moreover, only 11% of the 64,276 children with FA had no claims from an outpatient provider or an FA-related ED visit. As a result, the overwhelming majority of the analytic sample had an equal chance of inclusion in the survival analyses.

When evaluating the provision of guideline-informed care, we were unable to assess the number of EAI prescriptions; rather, with the Medicaid data available, we were able to evaluate only the number of EAIs filled. Several factors, such as FA beliefs, language barriers, cost, and distance to the pharmacy, may contribute to patients not filling prescriptions, even if primary care clinicians are providing guideline-informed care. Moreover, we were not able to assess if a patient was referred to an allergist; rather, we

could evaluate whether or not they presented to the allergist. There are several reasons, such as lacking access to transportation, FA beliefs, long wait times, and FA not deemed a pressing issue, that may prevent a patient from presenting to the allergist that do not reflect whether the primary care clinician provided the referral to specialty care. Although not all FA guidelines could be evaluated (eg, flu vaccinations, panel testing), we were able to evaluate key guidelines required for FA diagnosis and EAI fills, which are useful when assessing whether or not children on Medicaid are receiving basic, guideline-informed FA care. Future research should examine whether guidelines such as the use of panel testing, a practice associated with the misdiagnosis of FA, affect the likelihood of guideline-informed care.²⁹

CONCLUSIONS

This study advances understanding of guideline-informed care and service use among Medicaid-enrolled children with FA. We demonstrated socioeconomic disparities in access to guideline-informed care among specific segments of the Medicaid population that warrant further study and intervention. ■

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Author Affiliations: Center for Food Allergy and Asthma Research, Institute for Public Health and Medicine, Northwestern University Feinberg School of Medicine (MKK, AAD, ORN, JLF, RSG, LAB), Chicago, IL; University of Chicago (CEC), Chicago, IL; Ann & Robert H. Lurie Children's Hospital of Chicago (RSG), Chicago, IL.

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Address Correspondence to: Lucy A. Bilaver, PhD, Center for Food Allergy and Asthma Research, Institute for Public Health and Medicine, Northwestern University Feinberg School of Medicine, 750 N Lake Shore Dr, Ste 680, Chicago, IL 60611. Email: l-bilaver@northwestern.edu.

REFERENCES

- Gupta RS, Warren CM, Smith BM, et al. The public health impact of parent-reported childhood food allergies in the United States. *Pediatrics*. 2018;142(6):e20181235. doi:10.1542/peds.2018-1235
- Greenhawt M. Food allergy quality of life. *Ann Allergy Asthma Immunol*. 2014;113(5):506-512. doi:10.1016/j.anaai.2014.06.027
- Warren CM, Otto AK, Walkner MM, Gupta RS. Quality of life among food allergic patients and their caregivers. *Curr Allergy Asthma Rep*. 2016;16(5):38. doi:10.1007/s11882-016-0614-9
- Boyce JA, Assa'ad A, Burks AW, et al; NIAID-Sponsored Expert Panel. Guidelines for the diagnosis and management of food allergy in the United States: summary of the NIAID-sponsored expert panel report. *J Allergy Clin Immunol*. 2010;126(6):1105-1118. doi:10.1016/j.jaci.2010.10.008
- Otto AK, Dyer AA, Warren CM, Walkner M, Smith BM, Gupta RS. The development of a clinical decision support system for the management of pediatric food allergy. *Clin Pediatr (Phila)*. 2017;56(6):571-578. doi:10.1177/0009922816669097
- Gupta RS, Lau CH, Dyer AA, et al. Food allergy diagnosis and management practices among pediatricians. *Clin Pediatr (Phila)*. 2014;53(6):524-530. doi:10.1177/0009922813518425
- Landsman-Blumberg PB, Wei W, Douglas D, Smith DM, Clark S, Camargo CA Jr. Concordance with recommended postdischarge care guidelines among children with food-induced anaphylaxis. *J Pediatr*. 2014;164(6):1444-1448.e1. doi:10.1016/j.jpeds.2014.02.022
- Gupta RS, Springston EE, Warrior MR, et al. The prevalence, severity, and distribution of childhood food allergy in the United States. *Pediatrics*. 2011;128(1):e9-e17. doi:10.1542/peds.2011-0204
- Bilaver LA, Kester KM, Smith BM, Gupta RS. Socioeconomic disparities in the economic impact of childhood food allergy. *Pediatrics*. 2016;137(5):e20153678. doi:10.1542/peds.2015-3678
- Minaker LM, Elliott SJ, Clarke A. Exploring low-income families' financial barriers to food allergy management and treatment. *J Allergy (Cairo)*. 2014;2014:160363. doi:10.1155/2014/160363
- Mahdavinia M, Fox SR, Smith BM, et al. Racial differences in food allergy phenotype and health care utilization among US children. *J Allergy Clin Immunol Pract*. 2017;5(2):352-357.e1. doi:10.1016/j.jaip.2016.10.006
- Dunn JD, Sclar DA. Anaphylaxis: a payor's perspective on epinephrine autoinjectors. *Am J Med*. 2014;127(suppl 1):S45-S50. doi:10.1016/j.amjmed.2013.09.013
- Simons FER; World Allergy Organization. Epinephrine auto-injectors: first-aid treatment still out of reach for many at risk of anaphylaxis in the community. *Ann Allergy Asthma Immunol*. 2009;102(5):403-409. doi:10.1016/S1081-1206(10)60512-1
- Coombs R, Simons E, Foty RG, Stieb DM, Dell SD. Socioeconomic factors and epinephrine prescription in children with peanut allergy. *Paediatr Child Health*. 2011;16(6):341-344. doi:10.1093/pch/16.6.341
- Brooks T. Measuring and improving health care quality for children in Medicaid and CHIP: a primer for child health stakeholders. Georgetown University Health Policy Institute Center for Children and Families. March 2016. Accessed April 24, 2020. https://ccf.georgetown.edu/wp-content/uploads/2016/03/Measuring_Health_Quality_Medicaid_CHIP_Primer.pdf
- Cook NL, Hicks LS, O'Malley AJ, Keegan T, Guadagnoli E, Landon BE. Access to specialty care and medical services in community health centers. *Health Aff (Millwood)*. 2007;26(5):1459-1468. doi:10.1377/hlthaff.26.5.1459
- Timbie JW, Kranz AM, Mahmud A, Damberg CL. Specialty care access for Medicaid enrollees in expansion states. *Am J Manag Care*. 2019;25(3):e83-e87.
- Landsman-Blumberg PB, Wei W, Douglas D, Smith DM, Clark S, Camargo CA Jr. Food-induced anaphylaxis among commercially insured US adults: patient concordance with postdischarge care guidelines. *J Allergy Clin Immunol Pract*. 2013;1(6):595-601.e1. doi:10.1016/j.jaip.2013.07.003
- Adirim T, Meade K, Mistry K; Council on Quality Improvement and Patient Safety; Committee on Practice and Ambulatory Management. A new era in quality measurement: the development and application of quality measures. *Pediatrics*. 2017;139(1):e20163442. doi:10.1542/peds.2016-3442
- Keet CA, McCormack MC, Pollack CE, Peng RD, McGowan E, Matsui EC. Neighborhood poverty, urban residence, race/ethnicity, and asthma: rethinking the inner-city asthma epidemic. *J Allergy Clin Immunol*. 2015;135(3):655-662. doi:10.1016/j.jaci.2014.11.022
- Busse WW. The National Institutes of Allergy and Infectious Diseases networks on asthma in inner-city children: an approach to improved care. *J Allergy Clin Immunol*. 2010;125(3):529-537. doi:10.1016/j.jaci.2010.01.036
- Owusu-Ansah S, Badaki O, Perin J, Stevens M, Anders J, Wood R. Under prescription of epinephrine to Medicaid patients in the pediatric emergency department. *Glob Pediatr Health*. 2019;6:2333794X19854960. doi:10.1177/2333794X19854960
- Dyer AA, Lau CH, Smith TL, Smith BM, Gupta RS. Pediatric emergency department visits and hospitalizations due to food-induced anaphylaxis in Illinois. *Ann Allergy Asthma Immunol*. 2015;115(1):56-62. doi:10.1016/j.anaai.2015.05.006
- Taylor L, Waller M, Portnoy JM. Telemedicine for allergy services to rural communities. *J Allergy Clin Immunol Pract*. 2019;7(8):2554-2559. doi:10.1016/j.jaip.2019.06.012
- Gupta RS, Springston EE, Smith B, Warrior MR, Pongracic J, Holl JL. Geographic variability of childhood food allergy in the United States. *Clin Pediatr (Phila)*. 2012;51(9):856-861. doi:10.1177/0009922812448526
- Telehealth and rural health care delivery. National Conference of State Legislatures. August 2011. Accessed April 24, 2020. <https://www.ncsl.org/Portals/1/documents/health/RHTelehealth.pdf>
- Gagnon MP, Duplantie J, Fortin JP, Landry R. Implementing telehealth to support medical practice in rural/remote regions: what are the conditions for success? *Implement Sci*. 2006;1:18. doi:10.1186/1748-5908-1-18
- Bilaver LA, Kanelley MK, Fierstein JL, Gupta RS. Prevalence and correlates of food allergy among Medicaid-enrolled U.S. children. *Acad Pediatr*. Published online March 19, 2020. doi:10.1016/j.acap.2020.03.005
- Bird JA, Crain M, Varshney P. Food allergen panel testing often results in misdiagnosis of food allergy. *J Pediatr*. 2015;166(1):97-100. doi:10.1016/j.jpeds.2014.07.062

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eAppendix Figure. Primary Study Sample: Percent with Food Allergy-Related Service Among Children with a Food Allergy Diagnosis Continuously Enrolled in Medicaid in 2012 (n=117,514 children)

