

range, <20 IU/mL). Given the positive antimitochondrial and M2 antibody titer results, the patient underwent liver biopsy and was found to have granulomatous portal inflammation and bile duct inflammation that consisted of epithelioid cells, histiocytes, and rare giant cells consistent with primary biliary sclerosis stage 1 to 2. She was prescribed ursodeoxycholic acid and has maintained normal liver function test results and control of her urticaria and pruritus.

The second patient is a male adolescent presenting at the age of 17 years with daily pruritus and urticaria that began 8 months before this visit. His symptoms were unassociated with angioedema, abdominal pain, or respiratory symptoms, and the patient underwent autologous serum skin testing with appropriate positive and negative controls, which revealed a 20-mm wheal with associated flare. Thyroid function test and basophil histamine release assay results were negative. He was diagnosed as having CU and prescribed carbinoxamine, 4 mg twice daily, and ranitidine, 150 mg twice daily. Within a month, his urticarial resolved; however, he continued to have severe pruritus, so cyproheptadine, 4 mg twice daily, and hydroxyzine, 75 mg twice daily, were also given during the next several months without resolution of his pruritus. Subsequently, liver function tests were performed.

Aspartate aminotransferase and alanine transaminase levels were elevated at 101 U/L (reference range, 12–32 U/L) and 112 U/L (reference range, 8–46 U/L). The total bilirubin level was 1.6 mg/dL (reference range, 0.2–1.1 mg/dL). The results of his hepatitis panel and cytomegalovirus and Epstein-Barr virus titers were all negative. His γ -glutamyl transpeptidase level was elevated at 397 U/L (reference range, 15–85 U/L), and his alkaline phosphatase level was elevated at 485 U/L (reference range, 48–230 U/L). Because his liver function test results remained abnormal on subsequent testing, he underwent liver biopsy, which revealed marked bile duct proliferation, focal cholangitis, and advanced fibrosis consistent with autoimmune hepatitis and possible overlapping sclerosing cholangitis. Subsequent magnetic resonance cholangiopancreatography ruled out sclerosing cholangitis. He began taking daily prednisone, 60 mg, and azathioprine, 100 mg, with complete resolution of his urticaria, pruritus, and elevated liver function test results. His maintenance therapy now consists of azathioprine alone.

Case reports in the medical literature are extremely limited regarding the presentation of autoimmune liver disease in patients presenting with CU and pruritus without additional clinical signs.^{5–7} Previous case reports cite clinical symptoms of arthralgias or fatigue in addition to chronic urticaria and pruritus or the development of

skin involvement of urticarial lesions after diagnosis of a concurrent autoimmune condition.^{5–7} We describe 2 patients who presented with CU and pruritus without additional clinical signs or symptoms found to have autoimmune liver processes on further laboratory testing and biopsy. Current recommendations suggest minimizing laboratory evaluation in uncomplicated cases of CU; however, these cases suggest the broader laboratory assessment pursued by most specialists is still appropriate in patients with CU even in the absence of other signs or symptoms.

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Acceptability of an interactive asthma management mobile health application for children and adolescents



Asthma is the most common chronic health condition in children living in the United States.¹ Multiple therapeutic interventions are used to achieve optimal disease control, because poorly controlled asthma leads to increased patient morbidity and an increase in health care costs and usage nationwide.² Non-adherence with an asthma treatment plan is a significant contributing factor for overall lack of asthma control.³ Various strategies to promote adherence include self-management education, behavioral

modification techniques, and electronic dosing counters. The widespread penetration of mobile computing devices makes this a promising platform to leverage information technology to improve asthma adherence.

Mobile devices have increased in quantity and diversity during the past decade and access by children also has increased, with recent estimates that 75% of children 8 years and younger have access to a mobile device within their home.⁴ Individuals are routinely using Internet resources and mobile health (mHealth) applications (apps) to receive information about their health.⁵ However, despite the rapid growth in availability of mHealth apps, there are no current regulatory agencies that mandate review to determine whether these apps convey reliable and evidence-based

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Table 1
User learning of asthma trigger avoidance

	Survey before intervention	Survey after intervention
Number of triggers reported, mean (SD)	4.76 (1.87)	4.86 (1.85)
Number of correct avoidance strategies, mean (SD)	2.95 (2.20)	4.24 (2.19)
Percentage of correct avoidance strategies overall, mean	36.9	53.0
Percentage of correct avoidance strategies adjusted for number of reported triggers, mean	66.3	88.2

information.⁶ Huckvale et al⁷ determined that less than half the available mHealth apps specific for asthma contained evidence-based recommendations and none contained reliable information with supportive tools for self-management. We designed a novel, personalized, and interactive mHealth app (AsthmaCare) for Apple iOS devices for children and teenagers to improve self-management skills for asthma. Herein we report findings from a pilot study of our asthma mHealth app.

AsthmaCare uses an interactive and personalized user interface with medical content in accordance with current National Heart Lung Blood Institute asthma guidelines and clinical standards of care.⁸ The app provides daily reminders that appear on screen similar to an appointment notification from within a calendar for medication use and personalized trigger avoidance measures. Easy-to-understand icons, color coding, and language conforming to a third-grade reading level help users navigate setup and use of the app. Users activate an interactive asthma treatment plan through input of respiratory symptoms and/or use of rescue medication, based on a proprietary algorithm that is compliant with treatment guidelines.⁸ AsthmaCare uses gamification features through rewarding points based on controller medication use and degree of interaction with the app.

We enrolled 24 patients with persistent asthma (age range 9–16 years) from the allergy–immunology outpatient clinic at our institution. Participants were provided iPod Touch devices with AsthmaCare installed to use for 30 days. Baseline surveys were completed and parameters measured by the app included symptom logs, medication usage, reward points, and asthma control status. Medication adherence was assessed by comparison of recall 30 days before enrollment with electronic logging of medication use on each iPod Touch during the study period. At the end of the 30-day intervention period, patients returned for analysis of their devices and were administered a postintervention survey. Primary outcomes of this study were acceptability and usage patterns of AsthmaCare.

Twenty-four participants were enrolled, and 21 completed the 30-day pilot study. The mean age of the participants was 11.6 years, with a slightly higher ratio of boys (12 of 21, 57%). Twelve participants (57%) were prescribed more than 1 controller medication, and 8 of 21 (38%) were taking a combination agent consisting of an inhaled corticosteroid and a long-acting β -agonist. All participants used their iPod Touch at least once per day, with 17 of 21 (80.9%) using it multiple times each day throughout the intervention period. A secondary analysis of user engagement with AsthmaCare was verified through the reward system. Most subjects (81%) were able to unlock the highest reward tier level, and the remaining subjects achieved the second highest level, indicating consistent use throughout the 30-day period. Increased adherence with controller medicine was observed in 18 of 21 subjects (85%) during the intervention period compared with the 30 days immediately preceding enrollment.

Participants were asked to answer the same open-ended, paper-based survey questions, at baseline and at trial completion, of measures taken to avoid their relevant asthma triggers. Overall, this improved from 36.9% (mean 2.95 correctly identified techniques) to

53% (mean 4.24 correctly identified techniques) after the AsthmaCare intervention period (Table 1). After the intervention, 11 of the 16 participants with less than 100% correct avoidance measures (68.8%) had an increase in the percentage of correct self-reported trigger avoidance strategies. All participants (21 of 21) reported the implementation of at least 1 new trigger avoidance technique after the intervention period.

Written asthma action plans had previously been given to 12 of 21 patients (57.1%) before enrollment, which is consistent with past experience in our institution. In this subgroup, 4 subjects (33.3%) were not comfortable using the action plan, 6/21 (50%) never looked at it after leaving their office visit, and no subjects (0%) kept the action plan on their person. All (12 of 12) were more comfortable and preferred using AsthmaCare compared with their traditional written plans.

From a user acceptability standpoint, 21 of 21 participants (100%) reported a better understanding of their asthma after using the app and 20 of 21 (95%) preferred this medium for receiving asthma education compared with other modalities. All participants reported they would recommend AsthmaCare to friends and family members with asthma.

To our knowledge, this is the first report of user acceptability of an evidence-based, interactive asthma management mHealth app designed for children and adolescents. This prospective pilot study demonstrated that all users engaged with AsthmaCare at least daily, and most used the app several times each day. Users indicated a strong preference for mHealth apps over traditional methods such as paper-based asthma treatment plans. Limitations of our study include the lack of a control group, small sample, lack of clinical outcome measurements, study duration, and assessment of adherence.

AsthmaCare is a novel mHealth app designed to improve self-management of asthma for children and teenagers. It offers a functional, modern tool that engages users on a daily basis through medication reminders, trigger avoidance strategies, and an interactive treatment plan. Considerations for future mHealth app development include evidence-based self-management tools and prospective clinical trials to demonstrate efficacy.

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Referral patterns and no-show rates at an outpatient pediatric allergy/immunology clinic



Previous studies have demonstrated improved quality of life for patients with chronic rhinitis and asthma when cared for by an allergist compared with general practitioners.^{1,2} Pediatric allergists predominantly evaluate patients in an outpatient setting in private practice or academic centers, most of which are located within metropolitan areas and can limit accessibility to rural locations. We conducted a retrospective review of the electronic medical records (EMRs) of patients referred for initial consultation at our outpatient allergy–immunology pediatric clinic located in a tertiary care academic referral center. After a preliminary assessment of the number of new patient referrals, our analysis focused on 1-month periods, separated by seasons: October 2012, January 2013, and May 2013. Information obtained from the EMR included referral diagnosis, demographic information, and primary address location.

The diagnosis used during data collection was from the original outpatient consult submitted by the referring practitioner. Primary residence was determined from the patient's EMR, which is updated at every visit. The χ^2 test of trend, the Fisher exact test, and the Wilcoxon rank-sum test were used to determine statistical significance between groups.

There were 630 new patients scheduled during our time frame. Of these, 198 new referrals were scheduled in October 2012, 181 in January 2013, and 251 in May 2013. Of these, 52% (328 of 630) were boys and 48% (302 of 630) were girls. The mean age at time of referral was 5.9 years (SD 4.5 years). Medicaid was the primary insurance for 66% of referred patients; 32% had commercial insurance; and 2% were self-pay. Most referred patients lived within 15 miles (zone 1) of the clinic location (71%, 448 of 630). The remaining patients included 6.7% (42 of 630) from 15 to 30 miles away (zone 2), 12.4% (78 of 630) from 30 to 60 miles away (zone 3), and 9.8% (62 of 630) who lived more than 60 miles away (zone 4).

Referral sources were divided into internal (originating from providers within our institution), external, primary care, and subspecialty care. Thirty patients lacked the necessary information in their EMR to allow for inclusion in all analyses. Overall, 63.8% of referrals (383 of 600) were internal and 36.2% (217 of 600) were external. Primary care providers (PCPs) accounted 75.5% of referrals (453 of 600) and subspecialists accounted for 24.5% (147 of 600). Of subspecialists, 25.9% of referrals (38 of 147) were made by pulmonologists, 17% (25 of 147) by gastroenterologists, 15.6% (23 of 147) by ear, nose, and throat physicians, 12.2% (18 of 147) by dermatologists, 7.5% (11 of 147) by emergency department physicians, and 21.8% (32 of 147) by other subspecialists.

The most common referral diagnoses were allergic rhinitis (38.3%, 241 of 630) and food allergy (30%, 189 of 630). Other referral diagnoses included asthma (19.2%, 121 of 630), eczema (15.7%, 99 of 630), urticaria (8.3%, 52 of 630), immunodeficiency (4.4%, 28 of 630), angioedema (2.2%, 14 of 630), eosinophilic esophagitis (2.2%, 14 of 630), and other (7.3%, 46 of 630). Allergic rhinitis was the most frequently

reported referral diagnosis by distance, cited on 36.2% of referrals (162 of 448) for zone 1, 33.3% (14 of 42) for zone 2, 56.4% (44 of 78) for zone 3, and 33.9% (21 of 62) for zone 4. For the entire group, there was a mean of 1.3 diagnoses per patient referral. When analyzed by distance, zone 1 had a mean of 1.31, zone 2 had a mean of 1.21, zone 3 had a mean of 1.14, and zone 4 had a mean of 1.06 diagnoses per patient referral.

The overall no-show rate was 24.9% (157 of 630; Table 1). Most no-shows were referred for allergic rhinitis (39%, 61 of 157) and food allergy (35%, 55 of 157). Among all no-shows, 83% (130 of 157) lived within 15 miles. Patients living more than 180 miles from the clinic had a 60% no-show rate (3 of 5). We observed an increasing trend of a 5% increase in the percentage of show rate for every 1-U increase in zone ($P < .05$). Internal referrals had a no-show rate of 32.4% (124 of 383), whereas external referrals had a no-show rate of 15.2% (33 of 217; $P < .001$). Medicaid patients had a larger percentage of no-shows compared with those who had commercial insurance (16.2% vs 7.9%; $P < .05$). Of all no-show referrals, 77% (121 of 157) were made by a PCP. The no-show rate for internal PCPs was 38% (90 of 240) compared with 15% (31 of 213) for external PCPs. The no-show rates were comparable among the 3 different months per season, with no-show rates of 24.7% (49 of 198) in October, 26.0% (47 of 181) in January, and 24.3% (61 of 251) in May. There was a statistically significant difference in time from the referral being placed to the appointment date between those who showed (median 128 days, interquartile range 68–421) and those who missed their appointment (median 146 days, interquartile range 119–448, $P < .001$).

To our knowledge, this is the first study reporting outpatient allergy–immunology referrals to a pediatric academic medical

Table 1
No-show rates

Distribution	n/N (%)	<i>P</i> value ^a
Referral source, n/N (%)		
Internal	124/383 (32)	<.001
External	33/217 (15)	
PCP	121/453 (27)	.666
Internal	90/240 (38)	
External	31/213 (15)	
Subspecialty	36/147 (25)	
Referral zone, n/N (%)		
Zone 1	130/448 (29)	.011 ^b
Zone 2	3/39 (7)	
Zone 3	16/78 (21)	
Zone 4	8/62 (13)	
Referral diagnosis, n/N (%)		
Allergic rhinitis	61/241 (25)	.925
Food allergy	55/189 (29)	.131
Asthma	34/121 (28)	.413
Eczema	21/99 (21)	.379
Urticaria	9/52 (17)	.241
Wait times (d), median (IQR)		
No-show	146 (119–448)	<.001 ^c
Show	128 (68–421)	

Abbreviations: IQR, interquartile range; PCP, primary care provider.

^aP value based on Fisher exact test.

^bP value based on χ^2 linear trend across zones.

^cP value based on Wilcoxon rank-sum test.

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