

Patient characteristics associated with allergen immunotherapy initiation and adherence

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Allergen specific immunotherapy (SIT) is the treatment of choice for patients with systemic allergic reactions to *Hymenoptera* insects and is an important treatment option for patients with allergic rhinitis (AR), asthma, or both.¹ Compared with pharmacologic therapies, which provide temporary relief of allergy symptoms, SIT is the only potentially allergic disease-modifying treatment.² SIT reduces health care costs within 3 months of initiation,³ decreases the risk of developing asthma and new allergies,² and produces sustained clinical benefits after completion of a treatment course of 3 to 5 years.² SIT may be administered subcutaneously or locally.⁴ Subcutaneous delivery is the only US Food and Drug Administration–approved SIT formulation⁵ and the predominant route of administration in the United States,⁵ and is therefore the focus of this editorial.

Specific immunotherapy typically involves injections administered at the physician's office at least every 6 weeks for a duration of 3 to 5 years⁴ and does not usually confer immediate symptom relief. Consequently, patients must weigh the deferred but potentially long-term curative benefits of treatment against the immediate and prolonged demands of therapy. Because successful clinical outcomes require strong patient commitment to treatment initiation and adherence, patient characteristics such as demographics, illness burden, and insurance coverage are likely to influence the ultimate success of treatment. However, little is known about the characteristics of US patients who receive and adhere to SIT.

PATIENT CHARACTERISTICS ASSOCIATED WITH RECEIVING SIT

Although several studies outside the US have examined the effects of patient demographic and illness characteristics on the likelihood of receiving SIT, their relevance to US practice is unknown. Studies conducted in Italy, Denmark, and Germany, which included more than 3500 adults, used a variety of methods to assess patient characteristics associated with initiating SIT (see this article's [Table E1](#) in the Online Repository at

www.jacionline.org).⁶⁻⁸ Two studies found that higher levels of education,^{6,7} and another⁸ that higher social status among women, significantly increased the likelihood of receiving SIT. Patients with comorbid asthma were significantly more likely to initiate SIT than those without comorbid asthma in 2 studies.^{7,8} Other variables significantly associated with receiving SIT were younger age,⁷ greater severity of rhinoconjunctivitis,⁷ lower quality of life because of allergic illness,⁷ and living in a large city versus the countryside (among women only).⁸ Demographic variables with no effect on the likelihood of receiving SIT were household income and sex in one study,⁷ and, among men, town size and social status in another.⁸

We are aware of only 1 US study that examined patient characteristics associated with initiating SIT. This retrospective claims analysis of children (<18 years) enrolled in Florida Medicaid from 1997 to 2004 identified over 100,000 (3%) who were newly diagnosed with AR, of whom 3048 (3%) subsequently received SIT.⁹ Whereas the only study outside the US to examine sex as a predictor of receiving SIT found no effect,⁷ this study of US children showed that boys were 25% more likely than girls to receive SIT ($P < .0001$). Because the multivariate analysis controlled for the effects of other independent variables (including comorbid asthma) when examining the influence of each predictor, the preponderance of asthma in boys versus girls¹⁰ is not likely to explain this sex difference. Furthermore, because research suggests that boys and girls experience equivalent asthma severity and morbidity,^{11,12} sex differences in asthma-related burden also cannot adequately account for this finding. Regarding the influence of diagnosis on SIT initiation, the presence of comorbid asthma and atopic dermatitis in US children with AR significantly and independently increased the likelihood of receiving SIT (both $P < .0001$).⁹ Comorbid asthma also was significantly related to SIT initiation in studies of adults⁷ and men performed outside the US.⁸ No study outside the US has examined the effect of patient race/ethnicity on the likelihood of receiving SIT. In the United States, Hispanic children were significantly more likely to receive SIT than non-Hispanic black or white children ($P < .0001$).⁹ This disparity may be explained by greater asthma-related morbidity among Hispanic than black or white children reported in other research.¹³

PATIENT CHARACTERISTICS ASSOCIATED WITH SIT ADHERENCE

Comparisons of SIT adherence across studies are problematic because "adherence" has been variously defined. Among women but not men receiving SIT in Germany, diagnoses of AR and lichen simplex chronicus (neurodermatitis) significantly increased, and diagnosis of food allergy significantly decreased, the likelihood of self-reported SIT completion.⁸ Town size, social status, age, and former East or West Germany residency had no effect on SIT completion for men or women. A case-control study of 100 patients receiving SIT in India found no effect of sex, age,

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or education on SIT adherence, but a diagnosis of conjunctivitis and absence of a family history of allergic disease significantly increased the likelihood of nonadherence.¹⁴

Four US studies have reported aggregated findings for adults and children,¹⁵⁻¹⁸ and results generally parallel those reported in studies outside the US. Two studies reported that older patients were significantly more adherent than younger patients,^{15,18} and 3 studies found no effect of sex on adherence,¹⁵⁻¹⁷ with 1 reporting better (unspecified significance) adherence among females.¹⁸ Unlike findings reported for patients in Germany and India,^{8,14} the type of allergic disease had no effect on SIT adherence among patients receiving care at a military clinic or a private allergy practice.^{15,16} However, a retrospective claims analysis of patients in a health maintenance organization reported that patients diagnosed with both AR and asthma treated with ragweed allergen and with an identified allergen were significantly more likely to be adherent than those diagnosed with either AR or asthma alone, treated with allergens other than ragweed, and treated with an unknown allergen type ($P < .01$ for all).¹⁷

In a study of Florida Medicaid-enrolled children who received SIT, even though Hispanic children were significantly more likely to initiate SIT than black or white children ($P < .0001$), they had a significantly shorter duration of treatment ($P = .003$).⁹ In addition, Hispanic children were 1.5 times more likely to discontinue SIT within 2 years of initiation than white children (Cox proportional hazard, 1.53; $P = .001$). This finding parallels the poor adherence to long-term preventive asthma medications seen among Hispanic versus white children¹³ and may be explained, in part, by cultural beliefs among caregivers of Hispanic children that may affect medication use.¹⁹ In another US study, among children receiving SIT in a university-based allergy clinic, girls, nonwhite subjects, and those with nonprivate insurance were significantly more likely to be nonadherent than boys, white subjects, and those with private insurance ($P < .01$).²⁰

As SIT approaches its 100th anniversary, more information on patient characteristics associated with successful treatment in the United States is needed. In contrast with burgeoning, high-cost, high-tech allergy treatments yielding temporary symptomatic relief, SIT is a more traditional approach and the only available potentially curative treatment. In striking contrast, considerably more is currently known about patient characteristics in the United States that predict adherence to allergy medications. In support of this contention, a MEDLINE search of patient adherence to SIT using the following terms was conducted: (“Allergens”[MeSh] AND “Immunotherapy”[MeSh]) OR “Desensitization, Immunologic”[MeSh] AND (“Patient Compliance”[MeSh] OR “Health Resources”[MeSh] OR “utilization”[Subheading])). Among 86 references, 18 (21%) referred to care in the United States. Among these 18 articles, only 7 were original studies reporting compliance to subcutaneous SIT, 1 of which did not include patient factors associated with adherence. In contrast, a MEDLINE search to identify research on patient adherence to allergy medications (“Anti-Allergic Agents”[MeSh] OR “Anti-Allergic Agents”[Pharmacological Action]) AND (“Patient Compliance”[MeSh] OR “Medication Adherence”[MeSh])) yielded 136 references, 45 (33%) of which referred to care provided in the United States. Twenty-six of these 45 articles assessed patient factors associated with adherence of drug therapy. Thus, whereas 7% (6/86) of identified articles examined patient factors associated with SIT adherence in the United States, 19% (26/136) described patient factors associated with allergy medication.

Why is comparably so little known about the characteristics of US patients with allergic disease who receive SIT? One possible explanation is that funding for large-scale research may be more readily available for treatments developed by the pharmaceutical industry than for patient-specific treatments that are formulated within specialty practice. For example, the widely cited Allergy in America studies, sponsored by pharmaceutical companies,^{21,22} comprehensively characterize patient patterns of allergy medication use but entirely disregard SIT.

This is not to say that industry-sponsored research is necessarily flawed or biased. In fact, robust health economics and outcomes research methods developed by the pharmaceutical industry could be applied to explore and improve patient adherence to SIT. For example, specialty allergy clinics could analyze claims/billing data to identify current rates of premature SIT discontinuation and patient characteristics associated with patterns of adherence. Targeted interventions, such as reminder phone calls, letters of encouragement, and Web-based educational materials, could then be evaluated to determine whether they improve adherence. On a broader scale, professional specialty allergy associations could establish a collaborative research consortium to examine patterns of care, best practices, comparative effectiveness, and cost-related outcomes of care.

Ample data demonstrate that SIT is an effective treatment that can alter the course of allergic diseases. Although relatively few studies have been conducted to date, available data suggest that treatment initiation and adherence may be substantially influenced by patient demographic, illness, and insurance characteristics.

REFERENCES

1. Frew AJ. Allergen immunotherapy. *J Allergy Clin Immunol* 2010;125:S306-13.
2. Cox L, Atwater S. Allergen immunotherapy for allergic rhinitis and asthma. *Drug Benefit Trends* 2008;20:1-6.
3. Hankin CS, Cox L, Lang D, Bronstone A, Fass P, Leatherman B, et al. Allergen immunotherapy and health care cost benefits for children with allergic rhinitis: a large-scale, retrospective, matched cohort study. *Ann Allergy Asthma Immunol* 2010;104:79-85.
4. Cox L, Cohn JR. Duration of allergen immunotherapy in respiratory allergy: when is enough, enough? *Ann Allergy Asthma Immunol* 2007;98:416-26.
5. Cox L, Jacobsen L. Comparison of allergen immunotherapy practice patterns in the United States and Europe. *Ann Allergy Asthma Immunol* 2009;103:451-9.
6. Ciprandi G, Larosa M, Tesi CF, Cadario G, Fiocchi A, Romano A, et al. Doctors' and patients' educational levels affect immunotherapy prescription. *Int J Immunopathol Pharmacol* 2008;21:477-9.
7. Petersen KD, Kronborg C, Gyrd-Hansen D, Dahl R, Larsen JN, Linneberg A. Characteristics of patients receiving allergy vaccination: to which extent do socio-economic factors play a role? *Eur J Public Health* 2010 May 19. [Epub ahead of print].
8. Hommers L, Ellert U, Scheidt-Nave C, Langen U. Factors contributing to conductance and outcome of specific immunotherapy: data from the German National Health Interview and Examination Survey 1998. *Eur J Public Health* 2007;17:278-84.
9. Hankin CS, Cox L, Lang D, Levin A, Gross G, Eavy G, et al. Allergy immunotherapy among Medicaid-enrolled children with allergic rhinitis: patterns of care, resource use, and costs. *J Allergy Clin Immunol* 2008;121:227-32.
10. Akinbami LJ, Moorman JE, Garbe PL, Sondik EJ. Status of childhood asthma in the United States, 1980-2007. *Pediatrics* 2009;123(suppl 3):S131-45.
11. Moonie SA, Sterling DA, Figs L, Castro M. Asthma status and severity affects missed school days. *J Sch Health* 2006;76:18-24.
12. Schatz M, Clark S, Camargo CA Jr. Sex differences in the presentation and course of asthma hospitalizations. *Chest* 2006;129:50-5.
13. Asthma and Allergy Foundation of America, National Pharmaceutical Council. Ethnic disparities in the burden and treatment of asthma. Reston (VA): Asthma

- and Allergy Foundation of America and National Pharmaceutical Council; 2005.
14. Mahesh PA, Vedanthan PK, Amrutha DH, Giridhar BH, Prabhakar AK. Factors associated with non-adherence to specific allergen immunotherapy in management of respiratory allergy. *Indian J Chest Dis Allied Sci* 2010;52:91-5.
 15. More DR, Hagan LL. Factors affecting compliance with allergen immunotherapy at a military medical center. *Ann Allergy Asthma Immunol* 2002;88:391-4.
 16. Tinkelman D, Smith F, Cole WQ 3rd, Silk HJ. Compliance with an allergen immunotherapy regime. *Ann Allergy Asthma Immunol* 1995;74:241-6.
 17. Donahue JG, Greineder DK, Connor-Lacke L, Canning CF, Platt R. Utilization and cost of immunotherapy for allergic asthma and rhinitis. *Ann Allergy Asthma Immunol* 1999;82:339-47.
 18. Rhodes BJ. Patient dropouts before completion of optimal dose, multiple allergen immunotherapy. *Ann Allergy Asthma Immunol* 1999;82:281-6.
 19. Koinis-Mitchell D, McQuaid EL, Friedman D, Colon A, Soto J, Rivera DV, et al. Latino caregivers' beliefs about asthma: causes, symptoms, and practices. *J Asthma* 2008;45:205-10.
 20. Lower T, Henry J, Mandik L, Janosky J, Friday GA Jr. Compliance with allergen immunotherapy. *Ann Allergy* 1993;70:480-2.
 21. Allergies in America: a landmark survey of nasal allergy sufferers: adult. 2006. Available at: <http://www.mmcpub.com/scsaia/AdultSummary.pdf>. Accessed August 16, 2010.
 22. Pediatric allergies in America: a landmark survey of children with nasal allergies. 2008. Available at: <http://www.mmcpub.com/scsaia/pediatric.pdf>. Accessed August 16, 2010.

ALLERGY ARCHIVES

RUSH DESENSITISATION



Alexander
Fleming

Dr A. W. Frankland discusses early cases of "rush desensitization."

Freeman had coined this rather strange word, "rush," rather than "rapid," when patients with severe summer hay fever, and especially those with an associated asthma, came for immunotherapy just before the grass pollen season was about to start. These patients were admitted to the ward and every 4 hours had an increasing dose of the aqueous pollen extracts. Patients received 5 injections a day and remained in hospital for 4-6 days, generally stopping the injections if any one caused urticaria.

Freeman was asked whether he agreed that it would be worthwhile to attempt rush desensitisation in a male patient aged 32 who had osteomyelitis following a leg wound. The patient's infection could be controlled by penicillin but eventually urticaria from the antibiotic occurred and had to be stopped. "Nasty toxic stuff penicillin but go ahead if you think it is a safe procedure." Not toxic, but an allergic reaction, he was told.

Freeman was told later that the rush treatment had been very successful (1963) in the penicillin allergy patient without any reaction following the 54 injections. Could a similar method therefore now be used for adult patients who had food anaphylaxis? Freeman had no objection but advised that the starting dose should be the same as that used by Noon in 1911, 40 units (0.4 mL of 100,000 dilution).

The first patient was egg anaphylactic (and fish). There was no problem with the injections finishing with 1 cc of 100,000 units (1/10 dilution). The patient also underwent provocation with scrambled eggs before discharge. There were no continued maintenance doses and the patient did not relapse. The rush treatment in hospital was for 12 days.

The next patient was a female aged 16 with milk anaphylaxis. Shortly after leaving hospital she went abroad and wrote a year later that she could now eat cheese and deal with small amounts of milk and had no further anaphylaxis.

The third rush treatment was against fish in the patient who had been successfully desensitised against egg. He had a new girlfriend who loved fish and chips and he could not kiss her for at least 3 hours after she ate fish. Cod was used with a successful provocation test just before discharge from hospital. Three days later, one mouthful of herring caused anaphylaxis requiring hospital admission.

The fourth patient, aged 21, was very acutely allergic to eggs. He had repeated emergency admissions to hospital from the age of 5 years. He stopped feeding outside his own home and his quality of life was very low. The course of injections produced only 2 mild attacks of urticaria. He was discharged from hospital after 14 days and advised monthly maintenance injections for 2 years. He rang up 60 years later to say that the course of injections had completely changed his life. He wanted advice about his most recent granddaughter who, like him, had just developed flexural eczema at the age of 6 months. Would she become allergic to egg and could this in any way be prevented?

TABLE E1. Patient characteristics associated with SIT initiation and adherence: summary of studies

Study/country	Design and sample	Adherence definition and rate	Characteristics associated with SIT initiation/adherence
Studies outside US			
Maresh, 2010 ¹⁴ India	Retrospective chart review (during 6 mo of 2003) of adult patients receiving SIT at an allergy clinic in India identified 50 consecutive nonadherent subjects and 50 adherent subjects, who were prospectively interviewed by physicians.	Nonadherent subjects: patients who received ≥ 10 SIT administrations, discontinued SIT for ≥ 6 mo within the past 2 y, and were not lost to follow-up. Adherent subjects: patients who were currently receiving SIT and who had completed ≥ 2 y of SIT (35.7% of sample).	Associated with nonadherence No family history of allergic disease: OR, 3.7; 95% CI, 1.1-12.5; $P = .04$ Allergic conjunctivitis: OR, 6.3; 95% CI, 1.8-22.6; $P < .01$ Not associated with nonadherence Sex, age, education, AR, asthma, disease progression, allergy type, perception of SIT
Petersen, 2010 ⁷ Denmark	A prospective, nonrandomized comparative study of 210 consecutive patients with dust mite or pollen allergy referred to an allergy specialist for SIT during 2005-2006 and 156 participants in a population-based survey conducted from 2006-2007 who reported AR symptoms due to dust mites or pollen and did not receive SIT.	Not applicable	Associated with initiation Age ≤ 45 y vs >45 y: OR, 0.92; 95% CI, 0.89-0.95 Persistent rhinoconjunctivitis vs no or intermittent rhinoconjunctivitis: OR, 32.92; 95% CI, 9.16-118.35 Comorbid asthma: OR, 4.19; 95% CI, 1.86-9.44 College degree vs no education: OR, 51.79; 95% CI, 10.38-258.33 Lower quality of life because of allergy: OR, 1.11; 95% CI, 1.08-1.15 Not associated with initiation Sex, household income
Ciprandi, 2008 ⁶ Italy	Prospective, cross-sectional telephone interviews with 500 randomly selected patients with AR, 50% of whom had received SIT	Not applicable	Associated with initiation Higher educational level ($P < .01$) Not associated with initiation None
Hommers, 2007 ⁸ Germany	Cross-sectional analysis of data from the 1998 German National Health Interview and Examination Survey, a physician-administered, computer-assisted interview, identified 2,727 adults with physician-diagnosed allergic disease, of whom 1,630 (60% had undergone allergy testing and 296 (11%) had received SIT.	Patients who reported "completing treatment" (undefined by investigators): 65.5%	Associated with initiation Women: Large city vs countryside: OR, 2.51; 95% CI, 1.29-4.88 Medium vs low social status: OR, 2.60; 95% CI, 1.22-4.49 High vs low social status: OR, 2.26; 95% CI, 1.13-5.55 AR: OR, 3.82; 95% CI, 2.01-7.27 Food allergy: OR, 1.57; 95% CI, 1.00-2.46 Contact eczema: OR, 0.58; 95% CI, 0.38-0.89 Animal allergy: OR, 2.08; 95% CI, 1.36-3.19 Pollen allergy: OR, 4.53; 95% CI, 2.38-8.65 Men: AR: OR, 4.87; 95% CI, 2.37-10.0 Comorbid asthma: OR, 2.70; 95% CI, 1.62-4.50 Dust mite allergy: OR, 3.03; 95% CI, 1.93-4.74 Pollen allergy: OR, 4.18; 95% CI, 2.23-7.82 Not associated with initiation Men: Place of residence, social status, food allergy, contact eczema, animal allergy

(Continued)

TABLE E1. (Continued)

Study/country	Design and sample	Adherence definition and rate	Characteristics associated with SIT initiation/adherence
US studies	<p>Hankin, 2008⁹ United States</p> <p>Retrospective claims analysis of children (<18 y) enrolled in Florida Medicaid (1997-2004) newly diagnosed with AR examined predictors of SIT initiation in patients who either received SIT (n = 3,048) or did not (n = 99,342) and SIT adherence among those who received SIT and had at least 4 y of data after their first AR diagnosis (n = 520).</p>	Completed ≥ 3 y of SIT: 16%	<p>Women: Comorbid asthma, dust mite allergy Associated with completing SIT Women: AR: OR, 3.15; 95% CI, 1.01-9.78 Neurodermatitis: OR, 5.33; 95% CI, 1.45-19.62 Food allergy: OR, 0.40; 95% CI, 0.18-0.88 Not associated with completing SIT Men and women: Place of residence, social status, age, former East-West Germany, smoking status, asthma Men: Allergic condition, type of allergy</p>
More, 2002 ¹⁵ United States	Retrospective chart review of 381 patients (adults and children) receiving SIT as of September 2000 at a military medical center.	Received a SIT injection within the past 3 mo at the time of chart review; discontinued SIT at the discretion of their allergist or completed at least 5 y of SIT: 77.4%	<p>Associated with adherence Age <18 y (82.7%) and age >45 y (87.7%) significantly ($P < .001$) more adherent than age 18-45 y (67.8%) Retirees (83.1%) and family members (81.4%) significantly ($P = .004$) more adherent than active duty members (65.7%) Not associated with adherence Allergic condition, sex</p>
Rhodes, 1999 ¹⁸ United States	Retrospective chart review of 311 patients with AR (with or without asthma) who currently or previously received SIT at an allergy specialty clinic during 1982-1996.	Completed at least 3 y of SIT or discontinued SIT with allergist approval: 82%	<p>Associated with adherence Age ≥ 40 y (76%) significantly more adherent than age 21-25 y (45%; P value unspecified) Age ≥ 40 y (76%) significantly more adherent than age 16-20 y (38%; P value unspecified) Females more adherent than males (significant unspecified)</p>

(Continued)

TABLE E1. (Continued)

Study/country	Design and sample	Adherence definition and rate	Characteristics associated with SIT initiation/adherence
Donahue, 1999 ¹⁷ United States	Retrospective claims analysis (1988-1992) of 603 adult and child HMO members who had received at least 1 SIT injection and were continuously enrolled during the year before and 2 y after SIT initiation.	Received a total of at least 61 injections over 3.5 y (course completion): 67%	<p>Among age ≥ 40, 31-35, 21-25, and 16-20 y, males significantly less adherent than females (<i>P</i> value unspecified)</p> <p>Among age 11-15 y, girls significantly less adherent than boys (<i>P</i> value unspecified)</p> <p>Associated with a shorter duration of SIT</p> <p>Age 10 to <20 vs 20 to <40 y: OR, 1.44; 95% CI, 1.13-1.75</p> <p>Female: OR, 1.26; 95% CI, 1.04-1.48</p> <p>Allergen unknown: OR, 1.53; 95% CI, 1.22-1.84</p> <p>Not associated with a shorter duration of SIT</p> <p>Ragweed allergy, cat allergy, allergic condition</p> <p>Associated with SIT completion</p> <p>AR + asthma (43%) vs AR (28%) and vs asthma (13%; <i>P</i> < .01)</p> <p>Ragweed allergy > vs other allergy types (<i>P</i> < .01)</p> <p>Noncompleters were significantly more likely to have an unknown Allergen type than a known allergen type (38% vs 13%; <i>P</i> < .01)</p> <p>Not associated with SIT completion</p> <p>Sex</p>
Tinkelman, 1995 ¹⁶ United States	Retrospective chart review of 13,157 patients (adults and children) prescribed SIT at a private allergy practice and who ordered SIT extract within an 18-mo period before April 1, 1993. Patients received SIT either at the clinic located in the Atlanta metro area (in-house population; N = 9,808) or at another physician's office or medical facility (remote population; N = 3,349).	Patients who (1) ordered extract and received at least 1 SIT injection during the last 4 mo of the 18-mo study period; (2) first ordered extract during study mo 4-15 and had a follow-up visit before end of mo 18; (3) ordered first extract before mo 4 and reordered extract between mo 12-18; (4) discontinued SIT on allergist approval; or (5) continued to received SIT but did not follow recommended schedule were adherent: 83%	<p>Associated with adherence</p> <p>None</p> <p>Not associated with adherence</p> <p>Age, sex, diagnosis</p>
Lower, 1993 ²⁰ United States	Retrospective chart review of 315 children (age 5-18 y) who were prescribed SIT at a university-based medical center for at least 1 y before the study.	Had not received a SIT injection for past 6 mo	<p>Associated with adherence</p> <p>White (61%) vs nonwhite (36%), <i>P</i> < .01</p> <p>Male (58%) vs female (54%), <i>P</i> < .01</p> <p>Private insurance (56%) vs nonprivate insurance (46%), <i>P</i> < .01</p> <p>Not associated with adherence</p> <p>Comorbid asthma, comorbid atopic dermatitis, number of allergens received</p>

HMO, Health maintenance organization; OR, odds ratio.