Safety of home-based and office allergy immunotherapy: A multicenter prospective study

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During a 1-year period, 27 otolaryngic allergy practices recorded all systemic reactions to immunotherapy resulting from 635,600 patient visits and 1,144,000 injections. Sixty percent of injections were given at home. Major systemic reactions were observed after 0.005% of injections. There were no hospitalizations or deaths. Eighty-seven percent of major reactions began within 20 minutes of injection. Frequently observed risk factors for major reactions were buildup phase of immunotherapy, active asthma, and first injection from a treatment vial. Home and office injections had similar rates of total systemic reactions, but home-based immunotherapy had far fewer major reactions. Home-based immunotherapy was found to be safe. The methods and precautions used to treat patients with this degree of safety are specified and discussed. (Otolaryngol Head Neck Surg 1999;121:553-61.)

SAFETY ISSUES IN IMMUNOTHERAPY AND STUDY GOALS

Systemic anaphylactic reaction is the most important risk assumed by patients who undergo allergy immunotherapy. The reported incidence of immunotherapy reactions varies from less than 1% to greater than 36%.[1] Consequently, improving patient safety is of foremost concern.[2] Methods advocated by the American Academy of Otolaryngic Allergy (AAOA) for use to diagnose and treat allergy have been developed, since the Academy's inception in 1941, with the specific goal of ensuring maximum patient safety. Central precepts of the AAOA are that quantitative allergy diagnosis by skin end-point titration (SET) or by in vitro testing allows physicians to select safe immunotherapy starting doses[3,4] and that achievement of optimum maintenance treatment doses produces favorable clinical and immunologic changes without a great risk of inducing anaphylaxis.[5] Prior retrospective studies found a very low incidence of serious systemic reactions when immunotherapy was administered according to AAOA-endorsed techniques.[6,7] The major goal of this research was to determine the degree of safety when immunotherapy is practiced according to AAOA methods, by prospectively obtaining data on the incidence of immunotherapy reactions. Data-based recommendations derived from this study should help guide allergy practitioners in providing safe allergy immunotherapy.

Home-based Immunotherapy

Many variables influence the risk of reactions to immunotherapy. One of the most controversial of these is whether there is any difference in safety when immunotherapy is given at home rather than in a physician's office. Changing patterns of medical practice in response to managed care have led to many treatments being changed to an outpatient setting, raising concerns for potential compromises in patient safety. However, many patients prefer home treatment because costs are lower and because the inconvenience of office visits is a major reason for abandoning immunotherapy.[8] The 1993 American Academy of Allergy, Asthma, and Immunology (AAAAI) position statement on minimizing anaphylaxis[9] suggested that home therapy is likely to be less safe, and because resuscitation equipment is not available, they warn that anaphylaxis occurring at home is likely to be fatal. Their position statement therefore endorses only office treatment, and only when facilities and personnel are prepared to treat anaphylaxis. This opinion has been challenged by clinicians who argue that it is possible to provide adequate precautions for home treatment.[10,11] A second study goal was to compare the safety of treatment in both the home and office settings.

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Table 1. Reported risk factors for major systemic reaction

Risk factor	Reference
Excessive allergen dose	Van Arsdel and Sherman[12]
High dose in pollen season	
Prior systemic reaction	
Potent allergens	Lockey et al[13]
Inexperienced physician	Norman[14]
Error (wrong dose)	
Buildup immunotherapy phase	Tinkelman et al[15]
Injections less often than weekly	
High dose in mold season	
Injections closely spaced	Vervloet et al[16]
Unstable asthma	Gibofsky[2]
High allergen exposure	
Current increased symptoms	
High sensitivity (brittle)	Greineder[1]
β-Blocker treatment	
Rush immunotherapy	Bosquet and Michel[17]
Change to new allergy extract	
Patient age < 5 y	Hejjaoui et al[18]

Immunotherapy Risk Factors

Other variables that influence immunotherapy safety include unstable asthma, high allergen exposure, currently increased allergy symptoms, and history of prior serious reaction.[2] Known risk factors are listed in Table 1. A third study goal was to determine all identifiable risk factors by documenting the conditions present when reactions occurred.

Historic Anaphylaxis Experience

In 1980 allergy extracts were the second most common prescription for patients between ages 11 and 20 years.[19] Although frequently used, immunotherapy is potentially dangerous because a known reactive substance is intentionally administered to a patient who is known to be sensitive to it. In the first 45 years of immunotherapy, many fatalities were due to either use of excessive allergen doses or use of allergens with high sensitizing potential,[12] such as horse serum antitoxins.[13] Also, a history of reaction was found to be a good predictor of future reactions. Most reactions occurred from pollen immunotherapy, especially ragweed, when physicians failed to reduce the dose during peak pollen season. In the United States from 1895 to 1968, there were more than 70 deaths from allergy treatment.[13]

Modern Anaphylaxis Experience

Recently, there has been increased concern over the small number of serious immunotherapy reactions. Greenberg et al[20,21] noted that 38% of systemic reactions developed between 35 minutes and 6 hours after injection, and during the first hour, asthma symptoms requiring epinephrine developed in some patients. They raised concern that asthma attacks could occur during home therapy. The British Committee on Safety of Medicines (CSM) reported on 26 deaths and 357 serious systemic reactions in the United Kingdom between 1957 and 1986.[22] Most of the fatalities were in patients under the care of general practitioners who were relatively inexperienced in allergy management and who were using commercially prepared immunotherapy vials.[14] The British reaction rates were 20 deaths per million (0.002%) and 1 serious reaction per 10,000 (0.01%) injections. Two fatalities occurred where symptoms first appeared between 30 and 90 minutes after injection. The CSM concluded that these data warranted obtaining informed consent for immunotherapy patients, treatment only where full resuscitation facilities were available, and a 2-hour observation period after injections. After publication of this report, immunotherapy prescriptions in the United Kingdom underwent a substantial decline. In 1994 the US Food and Drug Administration published a summary and reviewed the warnings on allergenic extract labels.[23] The Food and Drug Administration estimated the annual US death rate from immunotherapy to be 0.7 deaths per million exposures (0.00007%).

Of 46 deaths in the United States between 1945 and 1984, only 1 followed home-based treatment, but data were insufficient to determine the reason.[13] Stewart and Lockey[24] and Reid et al[25,26] subsequently identified 1 more death between 1984 and 1991. This patient was receiving home treatment despite a history of multiple prior systemic reactions. Since 1984, 24 US patients died after immunotherapy. Of these, 15 reactions began within 20 minutes after injection, 1 between 20 and 30 minutes, and 3 beyond 30 minutes. In two thirds of these cases, the presence of a physician within 3 minutes of onset was not sufficient to ensure survival. Epinephrine was used in only 60% of fatal cases. Finally, almost a third of the deaths involved a mistake in dosage.[14] The modern US immunotherapy fatality rate, with estimates of 7 million to 10 million annual injections and 37 known immunotherapy deaths from 1945 to 1984, is about 0.00001%, or about 1 in 10 million.[24-26] This is 200-fold better than the modern data from the United Kingdom[22] and suggests that physician training and experience, as well as physician-supervised preparation of immunotherapy treatment vials, may be crucial factors in reducing deaths.

Tinkelman et al[15] prospectively studied almost 350,000 injections. Buildup patients had systemic reactions after about 5 of 10,000 (0.05%) injections. In contrast, about 0.03% of maintenance patients had reac-

tions. Six of 7 severe reactions occurred within 20 minutes, and the seventh occurred within 30 minutes of the injection. Twenty-nine percent of reactions were delayed beyond 30 minutes, and 3 patients developed significant asthma symptoms. In a 5-year retrospective analysis of more than 125,000 injections in 550 patients treated by AAOA methods, Davis et al[6] observed a combined major and minor systemic reaction rate of about 4 per 1000 (0.4%), with no deaths. The ratio of reaction rates for home treatment to office treatment was about 1:3. They believed that home treatment was safer because, in their practice, these patients were exclusively doing maintenance treatment, whereas office patients also received buildup therapy, which was known to cause more reactions.

Cook et al[7] reported on an AAOA membership survey in 1994. No deaths were reported by 592 members who were caring for approximately 450,000 patients and practicing allergy according to AAOA techniques. Three deaths were identified in other otolaryngic allergy practices, and 3 further deaths were identified in non–otolaryngic-allergy practices. There were 164 patients with systemic reactions from about 23.5 million immunotherapy doses administered in 1 year, or 7 per million (0.0007%). Systemic reactions were reported to have occurred during home treatment by 2.2% of the physicians who allowed home treatment. Finally, Brockow et al[27] prospectively studied insect venom inpatient rush desensitization in 121 patients, followed by monthly home maintenance immunotherapy. Fourteen patients had systemic symptoms during rush therapy (11.6%), but there were no systemic reactions during 50 weeks of home maintenance treatments.

STUDY DESIGN

This prospective study was carried out during a 12-month period in 27 US medical offices. Each office recorded data, using standardized reporting forms, on all allergy patients in their practices who were treated with subcutaneous injection immunotherapy at any time during the year. Participating physicians had all passed the fellowship examination of the AAOA, had been in practice for 5 to 15 years since completing residency training, and practiced allergy according to AAOA guidelines for diagnosis and treatment. The offices were geographically diverse and included 7 academic, 1 military, and 19 private practice sites. Contributing practices are listed in Appendix 1. Because of differences in patient tracking, some centers reported only the number of patient treatment encounters, and others reported only the number of separate injections given. Every treatment reaction that required medical observation or intervention was reported separately on an incident report form.

Reaction Definitions

Reactions to immunotherapy were defined as immediate if they began within 20 minutes of injection; otherwise, they were termed late. A reaction was considered systemic if it produced any symptoms at a location distant from the injection site. Major reactions included laryngopharyngeal, pulmonary, or generalized cutaneous symptoms, or any reaction that required the use of epinephrine and/or heparin or treatment in an emergency department or hospital. Events that did not meet major reaction criteria were considered to be minor.

Antigen Handling

Twenty-four practices used multiantigen, multidose vials, and 3 practices used multiantigen, single-dose vials. All used phenol-containing normal saline diluent, and 30% added albumin. Seventy-five percent of practices used a minimum glycerin concentration of 5% to 20% wt/vol (mean 12.5%) in treatment vials. Vials were refrigerated, and outdated after 2 to 6 months (mean 3.7) from mixing.

Dose Escalation

Patients initially received from 1 to 5 injections per visit (adult mean 2.6, pediatric mean 1.6). Twenty-one practices routinely separated the antigens into high- and low-sensitivity treatment vials, and in all practices the initial treatment doses were determined by SET or in vitro test results. Buildup injection frequency was once a week or, in 7 practices, twice weekly. In all practices, as a safety precaution, a 0.01-mL intradermal vial test was always used when initiating immunotherapy from in vitro test results. When treatment was begun from SET test results, an initial vial test was also used by 22 practices, whereas 5 began with an injection. During buildup, 14 practices used a vial test as the first dose from every new vial, whereas 13 reduced the initial dose from each new vial to half of the dose previously given. Escalation schedules varied from 0.02-mL weekly dose increases (3 practices), to 0.05 mL (17 practices), to a maximum of 0.10 mL (7 practices). For brittle patients, 23 practices reduced their usual dose increment.

Maintenance

In 25 practices, doses were escalated to a maintenance injection of 0.2 to 1.0 mL (mean 0.4 mL) of the maximum possible allergen concentration (maximum dose method) or were escalated to a level just below the dose, which caused unacceptable local or systemic reactions (optimum dose method). The maximum strength vials were prepared from 1:10 or 1:20 wt/vol allergen concentrates, or from comparably potent standardized allergens, and contained individual antigens at final

Table 2. Patients treated with home-based immunotherapy

Patient category	Practices treating at home (%)
Allergic rhinitis	93
Mild asthma	93
Normal pregnancy	80
Moderate asthma	70
Taking β-blocker	36
Severe asthma	25
Brittle or complex	25
Stinging insect	12

dilutions of 1:250 to 1:500 wt/vol. In 2 practices, doses were escalated up to a maximum of 0.5 mL of the SET or in vitro end-point dilution, or until patients had unacceptable local or systemic reactions (end-point dose method). Because most patients' end points ranged from 1:12,500 to 1:500 wt/vol, study patients received allergen doses within the range that was known to be clinically and immunologically effective.[3] Only 6.8% of patients were so brittle that they could not be advanced to doses above 1:12,500 wt/vol during the study. More than 60% of all patients tolerated maximum strength injections. Patients were treated for 3 to 5 years (mean 3.8 years) before an attempt was made to stop treatment. All practices treated patients at least weekly for the first year. In the second year, about two thirds of patients were treated every 2 to 3 weeks, and by the third year, only 9% of patients still required weekly injections for symptom control, while an equal number were treated monthly. After the third year, two thirds of patients were controlled by treatment every 3 to 4 weeks. Only 3 practices allowed patients to go as long as 5 or 6 weeks between maintenance injections without a dose reduction.

Injection Precautions

No drugs were included in treatment vials. Premedications were not used routinely, but 5 practices encouraged preinjection oral antihistamine use.[18,28,29] A physician or physician's assistant was present during injection hours in 13 offices. In all offices, injections were given only when 2 or more trained individuals were present. All practices had their physicians, and all but 2 practices had their nurses, currently certified in basic cardiopulmonary resuscitation. Ten practices also had 1 or more individuals certified in advanced cardiac life support. Patients were required to wait in the office for at least 20 minutes after injections.

Home-based Immunotherapy

Twenty-five practices (93%) allowed home injections. All had eligibility exclusion criteria but varied in the categories of patients who could qualify (Table 2). Before beginning home injections, all practices gave patients written instructions that described storage of treatment vials, advancement method, how to recognize reactions, and how to treat reactions. All practices provided epinephrine and antihistamine prescriptions and gave both injection technique and emergency treatment training. Patients were instructed to always have another responsible adult present when taking their injections and to promptly report any reaction to their physician. When more than 1 patient in a household was receiving immunotherapy, color-coded or distinctively marked treatment vials were used. Almost all practices confirmed that patients with asthma had a bronchodilator prescription, had patients sign an informed consent, and required patients to fill out and return a written record of their home injections. Twenty-three practices required patients to begin home treatment with a vial test, and 14 also required patients to return to the office for a vial test of each new treatment vial. Fifteen practices allowed only home maintenance treatment, whereas 10 also permitted buildup.

RESULTS

Reactions were tabulated by phase of immunotherapy (buildup or maintenance), location of injection, time of symptom onset, and severity. During 12 months, there were 277,000 recorded patient encounters in addition to 646,000 counted injections. Data are presented by encounter and by injection and are calculated for the total patient population. On the basis of practice demographic data, a conversion factor of 1.8 injections per encounter was chosen to calculate population totals from data based on both counted injections and recorded encounters. The combined study totals are 635,600 patient encounters and 1,144,000 injections (Table 3). Eighty-one percent of the injections were given during maintenance therapy. Sixty percent of the injections were administered at home: 59.6% at home, 32.5% in office, and 7.9% in another physician's office. A total of 131 reactions were reported during the study year. The overall reaction rate per counted injection was 0.020%, or about 1 reaction in 5000 injections. On the basis of the calculated injection total, the rate was 0.012%. One hundred reactions were minor, and 31 were major. The rate of major reactions was 0.0048%, about 1 in 21,000 counted injections or 1 in 37,000 calculated injections. Four patients received treatment in an emergency department, but there were no deaths and no hospital admissions. During the year, no practice participants were aware of a death in their community from allergy immunotherapy practiced according to AAOA guidelines.

Table 3. Number of patient encounters, treatment injections, and systemic reactions

	Counted		Calculated		Systemic reactions	
Injection type	Encounters	Injections	Encounters	Injections	Total	Major
All patients	276,678	646,012	635,600	1,144,000	131	31
Buildup	37,953	195,057	146,300	263,400	84*	28
Maintenance	238,725	450,955	489,300	880,700	47*	3
Home†	90,022	74,250	131,300	236,300	65	1
Office†	94,380	110,403	155,700	280,300	66	30

*In 2 cases of minor reactions, patients were receiving both maintenance and buildup injections.
†Numbers do not equal *all patients* total because the place where the injection was given was not recorded for all patients.

Table 4. Major systemic reactions (n = 31): Symptoms and treatment

	No. reported
Symptom observed	
Chest tightness	12
Wheezing	11
Angioedema	4
General urticarial rash	4
Treatment administered	
Oral antihistamine	31
Oral corticosteroid	17
β-Agonist inhaler	11
Subcutaneous epinephrine	9
Intravenous heparin	2

Table 5. Minor systemic reactions (n = 100): Symptoms and treatment

	No. reported
Symptom observed	
Injection site wheal > 2 cm	73
Arm swelling or urticaria	50
Sneezing or minor symptoms	10
Mild headache	8
Flushing or burning feeling	7
Lightheaded feeling	2
Treatment Administered	
Observation only	59
Oral antihistamine	41

Reaction Symptoms, Treatment, and Time of Reaction Onset

Symptoms and treatments for major reactions are shown in Table 4. In agreement with findings of prior studies, 27 of 31 major reactions began within 20 minutes after antigen injection. Because of the small number of major reactions, data for reactions occurring in the allergy office or in another physician's office were combined. Four major office reactions were reported as beginning after 20 minutes. However, the fact that these patients were still in the office when they required treatment suggests that before 20 minutes they were suspected of being a potential problem and were thus observed longer than usual. No late major reactions and only one major immediate reaction occurred at home. This single major home reaction resulted from ingestion of a known food allergen (nuts in a cake), followed the next morning by an inhalant allergen injection. The resulting increase in asthma symptoms was effectively treated at home by subcutaneous epinephrine. Most minor reactions were late onset and were about 1.4 times more frequent during home treatment. Symptoms and treatments for minor reactions are shown in Table 5.

Systemic Reaction Risk Factors

Eighty-three patients had reactions during buildup, 46 reactions occurred during maintenance immunotherapy, and in 2 cases, both buildup and maintenance injections were being given during the same treatment session. The incidence of all reported reactions by immunotherapy phase was thus 0.043%, or about 1 in 2300 counted buildup injections, and 0.010%, or 1 in 10,000 maintenance injections. Twenty-eight (90%) of the major reactions occurred during buildup. Major reactions occurred in 0.014% of buildup injections and 0.0007% of maintenance injections, a 20-fold difference (Table 6). Thus both major and minor reactions are substantially more common during escalation immunotherapy. Sixty-five reactions occurred at home, 54 reactions occurred in the allergy office, and 12 occurred in other physicians' offices. The incidence of reactions by location was 0.028%, or about 1 in 3600 home injections; 0.022%, or about 1 in 4600 office injections; and 0.035%, or 1 in 2800 injections given in other physicians' offices. The combined reaction rate for all physicians' offices was 0.024%, or 1 in 4300 injections. In terms of overall reaction incidence, injec-

Table 6. Observed rates of systemic reactions: Number of reactions per 100 counted or calculated injections

	Minor systemic reaction		Major systemic reaction	
Injection type	Counted	Calculated	Counted	Calculated
All patients	0.015	0.0087	0.0048	0.0027
Buildup	0.029	0.021	0.014	0.011
Maintenance	0.0098	0.0050	0.0007	0.0003
Home	0.086	0.028	0.001	0.0004
Office	0.033	0.013	0.027	0.011

Table 7. Observed risk factors for major systemic reaction

Risk factor	Patients with major reaction who had this risk factor (%)
Active asthma	46
New vial, first injection	10
Prior systemic reaction	7
Vial prepared in another office	6
β-Blocker treatment	4
Error (wrong patient's vial)	3

For buildup versus maintenance, the relative risk was 20 times higher for buildup; for office versus home, the relative risk was 26 times higher for office.

tion location does not greatly affect risk. However, all major reactions, except one, occurred in the office setting and not at home. The rate of major reactions in physicians' offices was 0.011% versus 0.0004% at home, a 26-fold difference. Finally, among the 72 patients who required medical treatment of their reactions, several additional risk factors were identified (Table 7). Importantly, no reactions occurred after a vial test.

DISCUSSION

Immunotherapy Safety

This large, prospective study has shown that allergy immunotherapy administered according to AAOA guidelines, either in the home or at an office, is very safe. Compared with previous reports, the low reaction rates, infrequent occurrence of serious reactions, and lack of deaths observed in this study may be partly explained by a difference in patient populations. Many otolaryngic allergists primarily treat rhinosinusitis patients. Further, the AAOA does not endorse rush immunotherapy, and not all members treat severe asthma or stinging insect allergies. However, otolaryngic allergists frequently do treat complex allergy patients with concomitant chemical, food, bacterial, and fungal hypersensitivity, and these patients often are brittle. Despite these possible differences, the types of reactions encountered and the risk factors observed are not different from those of other studies. In fact, the results of the only other large prospective private practice study[15] are very similar to those of this report, except that our reaction rate for maintenance immunotherapy is lower. In agreement with others, we found that reactions occurred most frequently in patients with asthma or a history of a prior reaction and only rarely during β-blocker treatment or through error. We also found a larger difference in relative risk between buildup and maintenance injections than had previously been reported. Newly identified, uncommon risk factors are receiving the initial injection from a new treatment vial and receiving an injection from a treatment vial prepared by another office.

Risk From Other Procedures

Data on allergy immunotherapy reactions should be considered in relation to the risk from other medical interventions. Immunoglobulin rarely causes serious reactions.[30] Transfusion fatalities are about 2 per million.[31,32] Finally, penicillin allergy causes about 75% of the approximately 500 annual US anaphylaxis deaths.[33,34] Rates of penicillin anaphylaxis range from 1 to 5 per 10,000, with fatalities occurring in from 15 to 20 per million treatment courses.[33] Reaction data from allergy immunotherapy and these other medical therapies are summarized in Table 8.

Preventing and Treating Reactions

Some of these reactions may have been preventable. For example, using an intradermal vial test as the initial dose from all treatment vials would have eliminated reactions due to dose errors, the initial injection from a vial, treatment from the wrong patient's vial, and reactions from vials prepared by other offices. Also, pretreating with antihistamines might have decreased minor reactions. However, because it is impossible to eliminate all risk during immunotherapy, both patients and their treating physicians need to cooperate to minimize risk. Because asthma is the single most common medical risk factor for immunotherapy reactions, it is prudent to be sure that asthmatics are under optimal medical and environmental control when they receive immunotherapy. Although all offices and homes had epinephrine available, it was not always used to treat major systemic reactions. Only 9 of 31, or 30%, were so treated. Infrequent use of epinephrine has been previously reported, but we believe that early epinephrine

Table 8. Reported rates of systemic reactions (per 100 injections)

Data source	Total reactions	Serious reactions	Fatal reactions	Reference
Allergy immunotherapy				
Academic	0.14	0.03	0	Van Arsdel and Sherman[12]
French	0.1	rare	0	Vervloet et al[16]
US military	0.25	0	0	Greenberg et al[20,21]
British incidents	NA	0.01	0.002	CSM[22]
AAAAI survey	NA	NA	0.00001	Lockey et al[13]
Literature summary				
Aqueous extract mean	0.5	NA	NA	Stewart and Lockey[24]
Modified extract mean	1.1	NA	NA	Stewart and Lockey[24]
Rush therapy mean	2.4	NA	NA	Stewart and Lockey[24]
Private practice				
Buildup	0.05	NA	0	Tinkelman et al[15]
Maintenance	0.03	NA	0	Tinkelman et al[15]
US health maintenance organization	0.5	0.09	0	Matloff et al[35]
AAOA academic	0.4	NA	0	Davis et al[6]
AAOA survey	NA	0.0005	0	Cook et al[7]
Italian	0.08	0.002	0	Businco et al[36]
Venom rush therapy	11.6	NA	0	Brockow et al[27]
Other medical therapies				
γ-Globulin	0.32	0	0	Gardulf et al[30]
Blood donation	2.5	0.04	0	McVay et al[37]
Blood transfusion	3.5	0.06	0.0002	McVay et al[37]
Penicillin therapy	0.05	NA	0.002	Erffmeyer[33]
This report				
All patients	0.020	0.0048	0	Hurst et al
Buildup	0.043	0.014	0	Hurst et al
Maintenance	0.0010	0.0007	0	Hurst et al
Home injections	0.028	0.0004	0	Hurst et al
Office injections	0.024	0.011	0	Hurst et al

NA, Data not available.

use for suspected anaphylaxis should be strongly encouraged.

Recommended Precautions

The very low rates of both major and minor reactions observed during this study indicate that the procedures and precautions used by these medical practices are effective in reducing the risk of reaction to allergy immunotherapy. The most important of these precautions are summarized in Table 9. Home-based immunotherapy is also strongly supported by these data because there was a much lower incidence of both major and immediate reactions occurring at home versus the office. The fact that all but one of the reported major reactions occurred in the office setting, whereas 60% of patients were being treated at home, is remarkable. The observed safety of home-based immunotherapy is likely due to a combination of careful patient selection, close adherence to AAOA procedures,[38] and prudent safety precautions. Some important additional considerations used to make the decision to allow home immunotherapy include (1) confidence in the patient's compliance with procedures and demonstrated ability to perform the injections; (2) trust in the patient's ability to respond to a reaction and willingness to report problems; (3) the brittle nature of the patient's disease; (4) potential ben-

Table 9. Recommended precautions for allergy immunotherapy

1. Adhere to AAOA procedures for diagnosis and treatment
2. Obtain written consent and provide careful patient education
3. Train staff and patients to diagnose and treat reactions
4. Consider using antihistamine premedication
5. Use specially marked vials for family members
6. Verify the vial and patient identity at every encounter
7. Be sure at least 1 adult capable of rendering emergency aid is present
8. Have epinephrine available wherever injections are given
9. Consider using a vial test as the first dose from every treatment vial
10. Use extra caution when treating patients with asthma
11. Use caution when treating patients who have had previous reactions
12. Use caution when treating patients who are taking β-blockers
13. Observe patient for 20 minutes after any antigen injection
14. Promptly use epinephrine for systemic reactions

efits from treatment in cases where noncompliance because of distance, convenience, or cost factors would result in no treatment; and (5) the physician's experience in managing allergy patients. Similar criteria must also be used to decide whether to allow dose escalation at home for selected patients. Finally, special consideration must be given when assessing the risks and benefits of treating complex or brittle patients at home.

Both home-based and office allergy immunotherapy are very safe, but a low rate of systemic reactions should not lead to complacency. Any physician administering allergy injections must anticipate the potential of life-threatening anaphylaxis. Appropriate precautions to prevent, and preparedness to manage, such events are critically important.

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