

Intranasal corticosteroids: The role of patient preference and satisfaction

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ABSTRACT

Allergic rhinitis (AR) is a disease with a significant global burden, associated with many comorbidities and quality-of-life issues. Overwhelming evidence shows that intranasal corticosteroids are the most effective treatment for AR to control the disease, decrease comorbidities, and decrease costs. Poor adherence is a major barrier to achieving control of AR. This article addresses patient preferences and satisfaction regarding intranasal corticosteroids and factors leading to better adherence. We review and summarize the published literature. Factors affecting patient preference and, ultimately, adherence include a variety of sensory components such as odor, taste, comfort of delivery, delivery devices (aerosol versus aqueous) and patient cost. The intensity of adverse sensory attributes is negatively correlated with patient preference and the likelihood of adherence. Selection of an intranasal steroid (INS) with patient preference and satisfaction in mind can influence patient outcomes and cost. Providers need to assess each patient to determine which inhaled INS will lead to the best adherence, thereby improving outcomes in our patients and ultimately reducing the overall global burden of this disease.

(Allergy Asthma Proc 35:24–33, 2014; doi: 10.2500/aap.2014.35.3725)

Allergic rhinitis (AR) is the most common form of allergic disorder in the United States, affecting up to 60 million people annually, with the global burden reaching almost 1.5 billion in number.^{1,2} The Joint Task Force Rhinitis Practice Parameter defines rhinitis as suffering from congestion, rhinorrhea (anterior and posterior), sneezing, and/or itching.³ Avoiding exposure to many allergens can be a difficult, if not impossible, task. Left untreated AR is associated with many comorbidities, including sinusitis, otitis media, asthma, sleep disturbances, and chronic fatigue. As a result, AR has been shown to interfere greatly with activities of daily living, leading to decreased productivity and absenteeism, with substantial direct and indirect costs.^{1,2} Therefore, patients typically require treatment with a pharmacologic agent. The most commonly accessible and prescribed therapies include various antihistamines, decongestants, corticosteroids, and anticholinergic agents.⁴ Topical corticosteroids have repeatedly been shown as the preferred anti-inflammatory therapy for persistent AR, being highly effective in preventing and relieving nasal symptoms associated with both early and late-phase allergic responses.^{5–8}

Despite evidence that intranasal corticosteroids are effective in improving nasal symptoms and quality of life in patients with AR, therapeutic intervention must include a patient's acceptance of and adherence to a treatment plan.^{8–10} This can at times be difficult, because patients may have poor perception of disease severity or may be focused on treating comorbidities associated with AR, such as recurrent sinusitis or sleep apnea.¹⁰ This article reviews published literature evaluating the concept of patient preference and satisfaction in selecting an intranasal steroid (INS) and how this can ultimately affect adherence, patient outcomes, and cost.^{11–14}

WHAT ARE THE WEAKNESSES IN HEALTH CARE?

Difficulties with patient adherence to prescribed medications may start with the physician–patient interaction. The Institute of Medicine published an article in 2001 titled “Crossing the Quality Chasm: A New Health System for the 21st Century” (The National Academy Press) where they identified key weaknesses in the quality of American health care.¹⁵ The consensus of the article is that the U.S. health care delivery system does not provide consistent, high-quality care to all American people. Increased patient-centered care was identified as one of the “six aims for improvement.” This means that health care should respect and respond to patient preferences, needs, and values. One particular need identified is that of health literacy, which is defined as the ability to read, understand, and use health care information to make informed decisions and thus comply with treatment. Studies reveal up to one-half of patients do not understand simple

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Presented at the Eastern Allergy Conference, May 30, 2013, Palm Beach, Florida
E Sher serves on the Advisory Board for Teva pharmaceuticals and receives research support and speaker honoraria from Sunovion, Meda, GlaxoSmithKline, and Teva. JA Ross has no conflicts of interest to declare pertaining to this article

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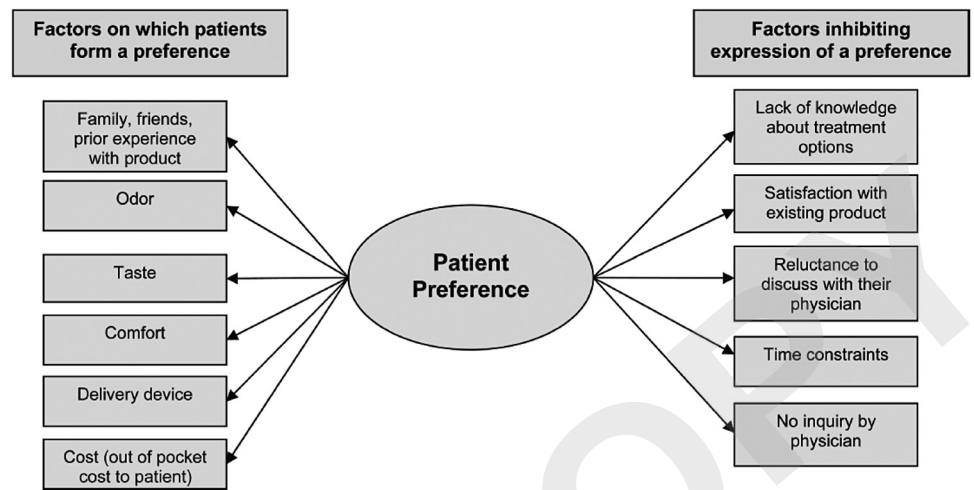


Figure 1. Factors which influence patient preferences. Source: Ref. ¹⁸.

health care instructions. Studies have shown that a higher health literacy score is an important predictor of medication adherence.^{16,17} To date, no studies have been performed on health literacy in rhinitis but this would be an important topic for future research.

FACTORS THAT INFLUENCE PREFERENCE

When choosing an INS the physician should ultimately try to make the best match between products available and the patient's clinical profile, keeping the patient's preference in mind. Factors that influence patient preference (Fig. 1) can be divided into factors on which patients form a preference including family, friends, or prior experience with a product. Other contributing factors include a variety of sensory components such as odor, taste, comfort of delivery, delivery device, and patient cost. Factors that might inhibit expression of a preference include patient lack of knowledge about different treatment options or satisfaction with their existing product so they may not ask for other treatment options. Patients may also be reluctant to discuss product preference with their physician. Time constraints during physician office visits often do not allow for such a discussion and very often physicians do not take the time to ask patients about preferences.¹⁸ Noncompliance is problematic across all medical therapeutic areas, especially if the patient is asymptomatic. AR is a chronic disease with asymptomatic periods, which can be a difficult barrier to overcome regarding patient compliance. However, if the disease is not controlled this can lead to the many comorbidities previously cited.

SATISFACTION

In The Allergies in America Landmark study, where 2500 adults with AR and the providers who treat them were surveyed, patients reported significantly less satisfaction than their providers ascribe.¹⁹ Almost all providers reported that their patients were very or somewhat satisfied with their intranasal corticosteroid

medication. In fact, only 35% of patients were very satisfied with their nasal prescription medication, indicating a significant communication gap between providers and the patients they treat. This dissatisfaction has been shown to lead to frequent medication switches or nonadherence. In fact 3 of 10 patients in the survey claimed that they changed their allergy medications, 10% several times a year, 8% once a year, and 12% every few years. In the National Allergy Survey Assessing Limitations study, 400 patients and 250 providers were surveyed 4 years after the publication of the Allergies in America study. The National Allergy Survey Assessing Limitations study continued to indicate significant dissatisfaction among patients, which often led to discontinuation of their nasal steroid medication.²⁰ Although providers agree INSs are the preferred treatment for AR, only 30% symptomatic AR patients report having used an INS in the preceding 4 weeks. Sensory attributes appeared to be a major factor in level of satisfaction. For example, when asked about discomfort, 92% of patients reported that they were "very" or "somewhat satisfied" if they did not feel any discomfort from the spray. This number dropped to 66% if the patients felt any discomfort from the spray.

REASONS FOR NONADHERENCE

In the Allergies in America survey patients were asked, "How many of the medicines that you have taken for allergy had the following types of side effects?"—some, most, or all of the patients complained of a dripping down the throat (41%), bad taste (32%), and a burning sensation (17%). The reasons for nonadherence are shown in Fig. 2. The overwhelmingly most common reason for nonadherence is measures pertaining to lack of efficacy. However, the next most common reason for nonadherence with nasal allergy medication (25% of patients) was because of bothersome side effects. Much lower incidences of nonadherence were caused by the product not being covered by insurance or copay being

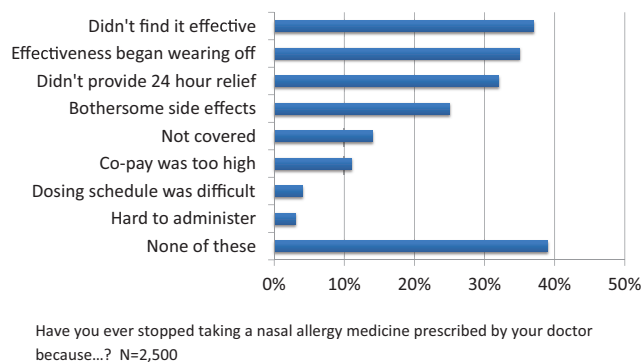


Figure 2. Factors influencing discontinuation of an intranasal steroid.

too high. With 25% patients stopping their nasal allergy medication because of bothersome side effects, this means these patients are largely not being treated or are grossly undertreated for their AR, contributing to the overall burden of this disease.¹⁹

COMPARING PATIENT PREFERENCES

Aqueous versus Aqueous Preparations

In one of the first studies of patient preference relating to sensory comparisons of intranasal corticosteroid sprays, Gerson *et al.*²¹ treated symptomatic adult AR patients with either aqueous suspension of triamcinolone acetonide (TAA AQ; 55 µg/spray), fluticasone propionate (FP; 50 µg/spray), or beclomethasone dipropionate (BDP; 42 µg/spray), 2 sprays to each nostril in random order (Table 1). Treatments occurred in 30-minute intervals. Before each treatment patients chewed unsalted crackers, rinsed mouth with water at room temperature, and sniffed a swatch of wool cloth, an established method for clearing the nose.^{22,23} They were immediately asked to use a 100-point scale to rate 13 attributes. At 2 minutes after administration they rated irritation, medicine runoff, and overall liking. The overall liking was greatest for TAA, presumably because of its lowest odor strength and better taste.

In a telemarketing study conducted in December 2000 by Kaliner *et al.*,¹⁸ allergy patients who had used either FP, TAA AQ, or mometasone furoate (MF) were interviewed regarding their preferences for INSs. A simultaneous physician survey was also conducted with 100 physicians meeting specific criteria for prescribing of nasal steroids and recruited from a nationally representative list of family physicians, general practitioners, and internists. The interviews were conducted *via* telephone. Of the physicians interviewed 98% of physicians believe sensory attributes of a nasal spray affect patient compliance. Of the patients surveyed, 97% would prefer a nasal spray with no odor and no aftertaste. However, less than one-half of the patients

(48%) said their physician asked about their satisfaction with the attributes of their INS. Thus, although physicians agree that satisfaction with sensory attributes affects compliance, there is discordance between what the physicians say and what they appear to be doing in practice. It should be noted that the MF being prescribed in 2000 was a scented product. The scent-free version of MF did not become available until 2005.

Bachert *et al.*¹² compared sensory attributes of TAA AQ, FP, and MF (scented product) in a double-blind crossover study looking at 14 sensory items (100-point scale) immediately after administration and four more questions answered 2 minutes after administration (Table 2). Patients were given the three nasal sprays in random order according to previously described methods.¹⁹ TAA compared with MF (scented) and FP rated higher with regard to better comfort, less irritation, less odor, preferred odor, more moistness, milder taste, and preferred taste. In fact, 54.7% patients said they prefer TAA over MF (24.2%) or FP (21.1%). In addition, more patients (67.4%) indicated that they would be more compliant with treatment with TAA than if given a prescription for MF (49.5%) or FP (54.7%). The conclusion was that sensory attributes of TAA were preferred over those of MF and FP and that patient preference may play a role in enhancing treatment compliance. Of note, full or modified versions of Bachert's questionnaire were subsequently used in the majority of studies on nasal spray preference evaluation summarized in this article.

Mahadevia *et al.*¹³ conducted a cross-sectional study with 120 patients across four U.S. allergy/immunology clinics. Respondents chose between pairs of hypothetical INSs differing in sensory attribute composition measured by strength of preferences for six sensory attributes (smell, taste, aftertaste, throat rundown, nose runout, and feel of spray in nose or throat) and three intensity levels (no taste, weak taste, and strong taste). Other measures included an importance score and willingness to adhere. Most important attributes to patients were as follows: aftertaste (28%), taste (19%), throat rundown (18%), nose runout (12%), smell (11%), and feel of spray (7%). If instructed to take the medicine daily for 3 months, 77% of patients stated that they would be willing to follow their physician's treatment plan if given an INS containing the lowest level of each sensory attribute. However, the willingness to adhere fell from 77% to only 4% if given an INS containing moderate sensory levels ($p < 0.01$). In conclusion, patient preferences are inversely proportional to increasing sensory attributes and affect patients' willingness to adhere to therapy.

Herman *et al.* performed a comparative review based on a Medline search of seven studies comparing sensory attributes of INSs from 1966 to 2004.^{4,12,13,21,24–27} Only five of these studies were designed to compare

Table 1 Summary of published data comparing patient preferences

Study	INSs (total dose)	Outcomes
Aqueous vs aqueous Gerson <i>et al.</i> ²¹	<i>n</i> = 94	Moistness of nose/throat, TAA AQ > BDP (<i>p</i> ≤ 0.01)
Double-blind crossover, immediate assessment	TAA AQ (220 µg) FP (200 µg) BDP (168 µg)	Liking of odor, TAA AQ > BDP (<i>p</i> ≤ 0.001), TAA AQ > FP, (<i>p</i> ≤ 0.001) Liking of taste, TAA AQ > FP, (<i>p</i> ≤ 0.05) Odor strength, TAA AQ > BDP (<i>p</i> ≤ 0.001), TAA AQ > FP (<i>p</i> ≤ 0.001) No significant difference between treatment arms for bitter taste Overall, TAA was preferred over BDP and/or FP
Kaliner <i>et al.</i> ¹⁸	<i>n</i> = 503 patients, 100 physicians	Physicians
Telemarketing study; physician vs patient questionnaire	Patients with prior use of FP, TAA AQ or MF	98% believed sensory attributes affect patient compliance Patients 97% prefer spray with no odor or aftertaste 48% had physician ask about satisfaction with sensory attributes
Bachert and El-Akkad ¹²	<i>n</i> = 95 TAA (220 µg) FP (200 µg) MF (200 µg)	TAA compared with both FP and MF: Better odor Milder taste Less aftertaste Less irritation TAA compared with FP: Better comfort, less irritating More moistness of nose/throat Overall, compliance more likely with TAA
Mahadevia <i>et al.</i> ¹³ Cross-sectional study	<i>n</i> = 120 Questioned regarding pairs of hypothetical INS differing in six sensory attributes (smell, taste, aftertaste, throat rundown, nose runout, and feel of spray) and intensity (none, weak, or strong)	Importance of attributes: Aftertaste > taste > throat rundown > nose runout > smell > feel of spray 77% willing to use prescribed medication if lowest level of each sensory attribute Fell to 4% if moderate sensory levels (<i>p</i> < 0.01)
Gross <i>et al.</i> ³⁶	TAA (220 µg; <i>N</i> = 172)	Patient preference inversely proportional to increasing sensory attributes Patient ratings of sensory attributes (reported complaints)
Single-blind parallel group, 3-wk treatment	FP (200 µg; <i>n</i> = 180)	TAA preferred over FP: Smell (<i>p</i> < 0.001) Irritation/burning (<i>p</i> < 0.05) FP preferred over TAA: Runout (<i>p</i> < 0.05) Caused sneezing (<i>p</i> < 0.05) TAA preferred for taste, less likely to cause epistaxis, and less blood in mucus, but not statistically significant Overall, TAA preferred

Continued

Table 1 Continued

Study	INSs (total dose)	Outcomes
Berger <i>et al.</i> ²⁶ Investigator-blind parallel, 3 wk	TAA (220 µg; <i>n</i> = 148) FP (200 µg; <i>n</i> = 147)	Patient ratings of sensory attributes: Better odor, TAA (<i>p</i> < 0.0001) Less epistaxis and nasal irritation, TAA (not significant) TAA overall preferred
Stokes <i>et al.</i> ⁴ Double-blind crossover; immediate assessment	<i>n</i> = 215 TAA (220 µg) FP (200 µg) MF (200 µg)	Patient ratings of sensory attributes (all statistically significant): On administration: Overall comfort, TAA = FP > MF Irritation, MF > FP = TAA Odor strength, FP = MF >> TAA Strength of taste, MF > FP > TAA Bitter taste, MF > FP = TAA Moist nose/throat, TAA > FP = MF After 2–5 min: • Aftertaste, MF > FP > TAA Irritation, MF > FP = TAA Overall, more patients preferred TAA than FP or MF, which was reflected in greater likelihood of compliance
Shah <i>et al.</i> ²⁷ Two studies, single-blind crossover, immediate assessment	<i>n</i> = 371 BUD (64 µg) FP (100 µg, 200 µg)	FP 200 µg >> BUD for scent, taste, aftertaste, throat run down, and nose run out FP 100 µg >> BUD for scent and taste BUD overall preferred and significantly more pleasing than either FP
Meltzer <i>et al.</i> ²⁸ Double-blind, single crossover, immediate assessment	<i>n</i> = 100 MF (200 µg) FP (200 µg)	Preference with regard to sensory attributes (<i>p</i> value): Scent/odor, MF (<i>p</i> < 0.0001) Immediate taste, MF (<i>p</i> = 0.002) 2-min taste, MF (<i>p</i> = 0.007)
Meltzer <i>et al.</i> ²⁹ Double-blind, crossover, immediate assessment	<i>n</i> = 127 FF (100 µg) FP (200 µg)	Preference with regard to specific attributes (<i>p</i> value): Scent/odor, FF (<i>p</i> < 0.001) Immediate taste, FF (<i>p</i> < 0.001) Aftertaste, FF (<i>p</i> = 0.002) Less drip down throat, FF (<i>p</i> = 0.037) Less runout of nose, FF (<i>p</i> < 0.001) Overall, patients preferred FF (<i>p</i> = 0.003) and were more likely to comply this product
Meltzer <i>et al.</i> ³⁰ Double-blind placebo-controlled, two-arm, 1-wk crossover	<i>n</i> = 360 FF (100 µg) FP (200 µg)	Preference with regard to specific attributes for active treatment (<i>n</i> = 181): Scent/odor, FF (<i>p</i> < 0.001) Leaking, FF (<i>p</i> < 0.001) Gentleness of mist, FF (<i>p</i> < 0.001) Aftertaste, FF (<i>p</i> < 0.001)

Continued

Table 1 Continued

Study	INSs (total dose)	Outcomes
Aerosol versus aqueous		
Berger, Western Society of Allergy, Asthma, and Immunology Meeting, 2012 ³⁰	<i>n</i> = 327	CIC-HFA was preferred over MF, with 15 of 17 preference scores being statistically significant, and the last two scores approaching significance
Double-blind, 2-wk crossover	CIC-HFA (74 µg) MF (200 µg)	Reported side effects and reduction in symptom scores were similar for both
Meltzer, AAAAI meeting poster, 2012 ³²	<i>n</i> = 185	Overall, higher preference scores for CIC-HFA (<i>p</i> < 0.0001)
1-wk crossover	CIC-HFA (74 µg) MF (200 µg)	Efficacy similar for both products in reducing symptom scores
		Overall, higher preference scores for CIC-HFA

TAA = triamcinolone acetonide; MF = mometasone furoate; FP = fluticasone propionate; FF = fluticasone furoate; HFA = hydrofluoroalkane; CIC = ciclesonide; INS = intranasal steroid; BDP = beclomethasone dipropionate; BUD = budesonide.

Table 2 Items on the nasal spray evaluation questionnaire

Item	Scale	
	Score = 0	Score = 100
Immediately after administration		
Overall comfort	Not at all comfortable	Extremely comfortable
Liking of odor	Dislike an extreme amount	Like an extreme amount
Liking of taste	Dislike an extreme amount	Like an extreme amount
Moist sensation	Extremely dry	Extremely moist
Urge to sneeze	None	Extremely strong
Odor strength	None	Extremely strong
Runoff	None	An extreme amount
Taste strength	None	Extremely strong
Bitter taste	None	Extremely bitter
Irritation	None	Extremely strong
Two minutes after administration		
Overall liking of product	Dislike an extreme amount	Like an extreme amount
Strength of aftertaste	None	An extreme amount
Runoff	None	An extreme amount
Irritation	None	An extreme amount

Source: Ref. 12.

patient preference based on sensory attributes. In conclusion, the patients in the aforementioned studies overwhelmingly preferred the unscented products budesonide and TAA versus scented MF and FP. All of these products had similar efficacy and safety. The authors concluded that factors preferred in an INS should be considered to promote better adherence to therapy. Note that the new scent-free version of MF was introduced shortly after the timeline of this study.

Meltzer *et al.* published several articles looking at preferences for sensory attributes.^{28–30} The first two studies used a double-blind single crossover, single-dose design with a modified Bachert questionnaire.¹² Symptomatic adult patients with AR were given pairs of INS medications 30 minutes apart, with established nasal cleansing in between as previously described.¹⁹ The first study involved 100 patients and compared the sensory attributes and overall liking for FP and the new scent-free MF with the results shown in Fig. 3.²⁸

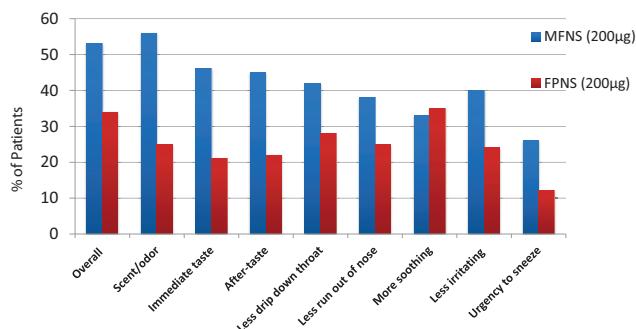


Figure 3. Reported sensory attributes MF vs FP.

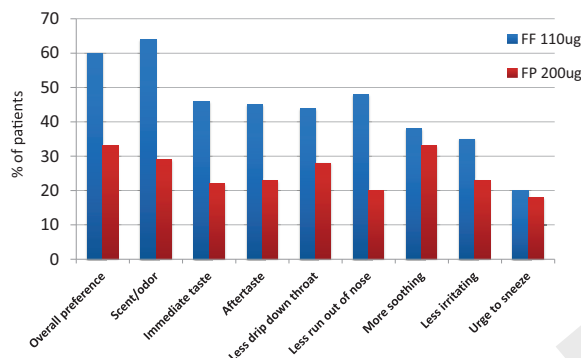


Figure 4. Reported sensory attributes FF vs FP.

MF was preferred in virtually every sensory attribute except "more soothing." Twice as many patients preferred MF to FP for scent/odor ($p = 0.0005$), immediate taste ($p = 0.005$), and aftertaste ($p = 0.005$). A total of 54% patients said they would prefer a prescription for MF compared with 33% for FP. In addition, 47% of patients said they would be more likely to comply with a prescription for MF compared with 25% for FP.²⁹ The second study compared fluticasone furoate with FP (Fig. 4).²⁹ Patients overwhelmingly preferred FF over FP in all sensory attributes. Many of the sensory attributes showed twice as many patients preferring FF over FP including overall product preference, 60% versus 33% ($p = 0.003$); odor, 64% versus 29% ($p < 0.001$); taste, 47% versus 21% ($p < 0.001$); aftertaste, 44% versus 22%; drip down throat, 43% versus 27% ($p = 0.037$); and nose runoff, 49% versus 19% ($p < 0.001$). Patients were more likely to comply with FF versus FP (52% versus 38%).

A third study by Meltzer *et al.* compared FF with FP in a 1-week double blind placebo controlled (DBPC) crossover study, as opposed to single-dose treatment. This study was a multicenter study involving 360 symptomatic adult AR patients. The patients filled out an eight-item questionnaire between each treatment arm. Patients again overwhelmingly preferred FF over FP ($p < 0.001$): scent/odor, 58% versus 27%; aftertaste, 60% versus 18%; leaking out nose and down throat, 59% versus 21%; and mist

Table 3 Patients who might benefit from aerosol INS

Patient Type	Reason
Polyps	Distribution pattern of spray
Olfactory disorder (mild hyposmia of AR)	Distribution pattern of spray
Postsurgery	Distribution into paranasal sinuses, may slow return of disease/inflammation
Presurgery	Drying effect and distribution of spray
Children and adolescents	Spray volume and feel
Wet AR (profuse rhinorrhea)	Drying effect and sensation
Previously failed AQ product	Distribution and preference may contribute to success
Bothered by side effects or can not tolerate AQ product	Preference may enhance compliance

Source: Ref. 11.

AR = allergic rhinitis; INS = intranasal steroid.

gentleness, 57% versus 26%. Efficacy was also evaluated with reflective total nasal symptom scores and found to be comparable between both groups.³⁰

Aqueous versus Aerosolized Preparations

A Special Issues Board was convened in October 2010 led by Dr. Allan Luskin and other thought leaders to assess consensus opinion on whether the loss of aerosol INSs after implementation of the Montreal Protocol left a gap in the treatment of AR. The Special Issues Board was given the job of determining whether aerosol nasal sprays might provide benefit for some patients. The results of this conference were published based on extensive review of the literature and personal opinions of the authors.¹¹ Several consensus statements were agreed on of which two are reported here:

There Is No evidence That Allows for the Clinical Superiority of Any INS versus Another in Terms of Efficacy, Assuming Use as Indicated and at the Recommended Doses.

There is a Need for Both a Nasal Aerosol Formulation and an Aqueous Formulation for INSs to Treat AR.

Based on the available data, the faculty suggested reasons patients might prefer an aqueous or aerosol nasal spray (Table 3). Since the publication of this consensus article, two new aerosol intranasal cortico-

steroids have been approved for use in the United States: ciclesonide–hydrofluoroalkane nasal aerosol (CIC-HFA) and BDP nasal aerosol (BDP-HFA). A patient preference study with CIC-HFA versus MF was recently reported using a newly validated 17-attribute preference questionnaire: the Allergic Rhinitis Treatment Satisfaction and Preference questionnaire with scores ranging from 0 to 100.^{31–33} At the end of the study a coprimary assessment (score >50 = higher preference for CIC-HFA, 50 = no preference, and <50 = greater preference for MF) was performed. Berger *et al.*³¹ presented data from a 2-week DBPC crossover study in 327 patients, with all 17 preference scores showing higher preference for CIC-HFA than for MF, with 15 of the 17 items being statistically significant. Many of the attributes showed at least twice the preference for the aerosol product CIC-HFA compared with MF aqueous.³¹ Meltzer showed data from a 1-week DBPC crossover study with a similar design, showing comparable findings.³² These data offer convincing evidence that patients not only show a preference for products with no odor or taste, but that a significant additional preference was shown for aerosol intranasal products. Significant differences were noted in most sensory attributes (including running down the back of the throat and out of the nose) reported in the extensive Allergic Rhinitis Treatment Satisfaction and Preference questionnaire.

Additionally, a study by Gross *et al.*³⁴ presented a 6-week randomized, DBPC, parallel-group study on a BDP-HFA device with integrated counter, specifically looking at safety, ease of use, efficacy, and patient satisfaction compared with previous nasal spray usage, using the Nasal Device Ease of Use and Satisfaction Questionnaire. Patients specifically reported increased satisfaction and ease of use of the aerosol device compared with previous aqueous nasal corticosteroids. One limitation to this study was the possibility of recall bias, because the patients were asked to recall specific details of previously used nasal spray devices.

CAN PATIENT PREFERENCES INFLUENCE HEALTH CARE COSTS?

A study by Hankin *et al.*¹⁴ published in 2012 reviewed retrospective Medicaid claims in Florida from July 1998 to December 2001 and looked at health care costs and medication adherence. Patients were included in the analysis if they had newly diagnosed AR and received a *de novo* prescription for either a pressurized INS formulation (pMDI) or an aqueous INS formulation (A-INS) and had 18 months of continuous enrollment after the index INS claim. Only patients who received one of the following formulations were included because these were

the only INS formulations with both an A-INS and a pMDI on the market, allowing for better comparison data: BDP, budesonide, or TAA. They analyzed the medication possession ratio, which is a direct measure of the percentage of time a patient is in possession of medication. They found that patients on the pMDI were in possession of their medication 53.2% of the time versus 34.7% for the A-INS patients. The pMDI patients also had fewer mean days between medication fills (73 days versus 111 days) compared with the A-INS group. In addition, the total health care costs were significantly lower in the pMDI patients, attributable to lower mean pharmacy costs at all follow-up visits but with the largest reduction at 18 months. This was attributable to greater use of non-INS medications in the A-INS group compared with pMDI. Patients with pMDI had 33% fewer median pharmacy fills and lower median costs (\$1285 versus \$2178; $p < 0.01$). This is the first study showing that sensory attributes of INS formulations have been associated with substantial and statistically significant differences in health care use and costs. A limitation of this study is the use of a retrospective study design, which makes it difficult to infer a cause-and-effect relationship. This shows the desire and need for prospective studies analyzing if use and compliance of INSs leads to reduction in the overall costs of both pharmacy claims and overall health care dollars in the treatment of AR.

Studies available to date show that patients are generally less likely to use generic versions of medications based on several parameters, including concern for efficacy, exposure to advertising, and perceived severity of illness.^{35,36} Patient preference leads to better compliance; therefore, physician acknowledgment of patient concerns may provide for more generic medication use and possibly decreased health care costs. Per our knowledge, no study has looked at the effects of cost of generics versus brand name in the role of patient compliance. We believe that a prospective study analyzing this particular information would be of use to prescribing physicians, along with what out-of-pocket cost patients are willing to spend to have a medication with the sensory attributes that they desire.

CONCLUSIONS

AR carries a substantial global burden of disease affecting nearly 1.5 billion worldwide. These patients can suffer from substantial comorbidities when undertreated, directly affecting quality of life and resulting in unnecessary direct and indirect medical costs. INSs will likely continue to be the first-line treatment of AR and barriers associated with use and compliance needs to be considered as a part of physician prescribing practices. Evidence suggests that many patients choose

to take their medicines or not based on sensory characteristics usually preferring sprays with no odor or aftertaste.^{12,19,28,37,38} The current process for selecting a particular INS is not ideal, because many physicians randomly select an agent and wait to assess results.¹¹ Ideally, physicians should have some understanding of the differences between INS products and take them into account when a selection is made.

Studies have indicated that patient preference and satisfaction directly relate to adherence of intranasal corticosteroids. The intensity of adverse sensory attributes is negatively correlated with patient preference and likelihood of adherence.¹³ Asking patients if odor or taste of a medication would change their use or compliance could limit medication changes and may improve patient adherence, satisfaction, and overall effectiveness of treatment.¹⁹ Additionally, inadequately treated AR can result in increased direct costs of resource use, including frequent office visits. Similarly, it can lead to increases in indirect costs related to absenteeism, productivity losses, and declines in quality of life. Enhanced targeting of therapy based on patient preference and satisfaction in mind can not only lead to better overall disease control, but can also influence cost and ultimately decrease the global burden of AR.¹⁴

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