

# How and by whom care is delivered influences anti-inflammatory use in asthma: Results of a national population survey

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**Background:** Studies examining the influence of provider behavior and patterns of care delivery on the use of anti-inflammatory asthma therapy have been limited to selected populations or have been unable to assess the appropriateness of therapy for individuals. We have previously reported the influence of sociodemographic variables and asthma severity on reported use of asthma medications in the United States. **Objective:** We sought to examine the influence of patterns of care delivery and clinician behavioral factors on the use of anti-inflammatory medication by patients with asthma. **Methods:** We performed a cross-sectional national random digit dial household telephone survey in 1998 of adult patients and parents of children with current asthma. Respondents were classified as having current asthma if they had a physician's diagnosis of asthma and were either taking medication for asthma or had asthma symptoms during the past year. **Results:** One or more persons met the study criteria for current asthma in 3273 (7.8%) households in which a screening questionnaire was completed. Of the 2509 persons (721 children <16 years of age) with current asthma interviewed, 507 (20.1%) reported current use of anti-inflammatory medication. In a multiple logistic regression model controlling for asthma symptoms, reported anti-inflammatory use was significantly associated with patients reporting their physician having an excellent ability to explain asthma management (odds ratio [OR], 1.47; 95% CI, 1.09-1.98), scheduling regular visits to a physician for asthma (OR, 1.30; 95% CI, 1.02-1.64), having a written asthma action plan (OR, 1.63; 95% CI, 1.29-2.06), and being of white, non-Hispanic ethnicity (OR, 1.53; 95% CI, 1.19-1.98), along with markers of greater asthma morbidity, missing 6 or more days from work or school in the past year (OR, 1.29; 95% CI, 1.01-1.65), and hospitalization for asthma in the past year (OR, 1.74; 95% CI, 1.19-2.53). Anti-inflammatory use was less likely

to be reported with younger age (OR, 0.82; 95% CI, 0.73-0.94), lower long-term asthma symptom burden (OR, 0.82; 95% CI, 0.71-0.94), use of 4 or fewer reliever inhaler canisters in the past year (OR, 0.50; 95% CI, 0.43-0.58), and smoking (OR, 0.50; 95% CI, 0.37-0.68).

**Conclusion:** How asthma care is delivered influences the use of anti-inflammatory medication. Strategies to increase regular evaluation by a physician interested in asthma, particularly for minority patients, and to increase a physician's ability to communicate asthma management to patients might improve use of anti-inflammatory therapy among patients with asthma. (J Allergy Clin Immunol 2003;112:445-50.)

**Key words:** Asthma, population survey, asthma medication, quality of care, physician-patient communication

A number of studies have indicated suboptimal use of anti-inflammatory medication by persons with asthma.<sup>1-5</sup> Patterns of provisions of health care,<sup>6</sup> including nonspecialist care,<sup>7</sup> have been described in various populations as important factors affecting the use of asthma medication. Deficiencies in the skills necessary for self-management of asthma coupled with therapeutic nonadherence and psychosocial dysfunction have also been associated with suboptimal use of asthma therapy.<sup>8-13</sup>

These studies were limited by the selected subpopulations used, such as inner-city children or managed care populations. Thus they provided little information that was representative of the US population. Many of these studies were based on automated databases or limited survey data that lacked detailed clinical information on individuals, making it very difficult to determine the appropriateness of therapy.

We have previously reported the influence of sociodemographic variables and asthma severity on reported use of asthma medications in the United States.<sup>14</sup> The main aim of this article is to describe the effect of how care is delivered, including health insurance and the influence of physician-patient interaction on self-reported use of asthma medication in the United States, specifically use of anti-inflammatory therapy.

## METHODS

The data for this study come from a national sample of adult patients and parents of children with current asthma. The methods for this study have been described in detail previously.<sup>14,15</sup> Eligible

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**TABLE I.** Demographic characteristics of the sampled population (n = 2509)

| Variable and category      | N (unweighted) | % (weighted) |
|----------------------------|----------------|--------------|
| Age                        |                |              |
| <6 y                       | 202            | 8.1          |
| 6-15 y                     | 519            | 20.7         |
| 16-34 y                    | 728            | 29.3         |
| ≥35 y                      | 1058           | 41.8         |
| Female sex                 | 1554           | 61.7         |
| Race                       |                |              |
| White, non-Hispanic        | 1807           | 70.2         |
| Black, non-Hispanic        | 323            | 12.7         |
| Other, non-Hispanic        | 173            | 7.3          |
| Hispanic                   | 177            | 8.7          |
| Marital status             |                |              |
| Partner                    | 1510           | 60.3         |
| Single, previously married | 459            | 18.1         |
| Single, never married      | 528            | 21.2         |
| Education                  |                |              |
| Less than high school      | 375            | 14.9         |
| High school                | 838            | 32.9         |
| More than high school      | 1284           | 51.7         |
| Employment                 |                |              |
| Employed                   | 1588           | 63.6         |
| Unemployed                 | 139            | 5.5          |
| Retired/student/homemaker  | 770            | 30.3         |
| Income                     |                |              |
| <\$15,000                  | 468            | 18.4         |
| \$15,000-\$35,000          | 623            | 24.7         |
| \$35,001-\$50,000          | 805            | 32.1         |
| >\$50,000                  | 613            | 24.9         |
| Residence                  |                |              |
| City                       | 1498           | 60.8         |
| Not city                   | 993            | 39.2         |
| Smoking (yes)              | 505            | 20.0         |

*Abbreviation used*  
OR: Odds ratio

subjects were identified by means of telephone screening of a national random digit-dialing sample of 42,022 households with telephones from May to June 1998. Persons were classified as having current asthma if they had ever been given a diagnosis of asthma by a physician and if they either took medication for their asthma or had asthma symptoms in the past year. If more than one household member qualified as a patient with current asthma, one designated respondent in each household was randomly selected by computer. One or more persons with current asthma were identified in 3273 (7.8%) households, and survey interviews were completed by trained interviewers with 2509 (76.7%) patients with asthma or their parents. The majority of eligible subjects who were not interviewed (94.6%) were awaiting callback when the field period for the study ended, and only 150 (4.6%) qualified respondents refused to conduct the interview or terminated the interview before completing it. There was no incentive offered to either the general public or patient samples.

### Questionnaire

Patient screening and interviews were conducted between May 21 and July 19, 1998. The interview averaged 30 minutes in length. Survey items covered a number of areas, including patterns of care

delivery, including type of provider and visit frequency; ratings of patient-physician interactions; and attitudes and beliefs regarding asthma and asthma therapy.

To fully characterize medication use, a series of 4 questions was used. Over a time frame of the last 4 weeks, interviewers inquired about (1) prescription medication for quick relief from asthma symptoms, (2) prescription medication to treat airway inflammation, (3) any other prescription medications for asthma, or (4) any over-the-counter medication for asthma. Medications classified within the anti-inflammatory group in this study included all inhaled corticosteroids, cromolyn and nedocromil, and oral antileukotriene preparations.

### Asthma burden classification

Asthma burden was divided into 3 components: short-term symptom burden, long-term symptom burden, and functional effect. Short-term symptom burden was categorized on the basis of reported daily and nocturnal symptoms over the past month. Long-term symptom burden combined the functional effect of asthma, together with long-term symptoms, including the frequency of average weekly symptoms and asthma exacerbations over a 12-month period. Functional effect comprised 3 components: physical, social, and nocturnal effect. Components of functional effect were graded on a 4-point Likert scale from 0 (none) to 3 (a lot). Respondents were asked the following: "How much do you feel that asthma limits what you can do in each of the following areas? Do you feel your asthma restricts you in" sports and recreation, normal physical activity, housekeeping chores, social activities, friendships, lifestyle, and sleeping? The criteria used were based on the NAEPP Expert Panel II recommendations for assessing asthma severity,<sup>16</sup> resulting in 4 categories of increasing severity (mild intermittent and mild, moderate, and severe persistent).<sup>14</sup> No lung function data were available.

### Statistical analysis

The main outcome of interest was reported use of anti-inflammatory therapy during the past month. Asthma burden, as assessed on the basis of short-term symptoms and long-term symptom burden, was used as the main variable for stratification in all analyses. We then examined the effect on medication use within each stratum of patterns of care delivery, including type of provider and frequency of visits, type of health insurance, and patient ratings of patient-physician interactions. Data have been weighted by age, sex, and probability of selection in the household to census estimates so that the health estimates calculated would be representative of the population. This resulted in occasional minor rounding effects for the numbers. Differences in the proportion of persons reporting medication use in each stratum were assessed for significance by means of  $\chi^2$  tests and Mantel-Haenszel methods for analysis of  $2 \times k$  tables. Multiple logistic regression was used to assess independent effects in models for anti-inflammatory therapy use. Variables significant at the 0.10 level in bivariate analysis were entered simultaneously into a multiple logistic regression model. The model was examined for goodness of fit, and correlations between variables within the model were also examined.

### RESULTS

Details of the demographic profile of the study subjects are given in Table I. Anti-inflammatory medication use varied significantly ( $P < .01$ ) between those with intermittent and persistent short-term asthma symptom burden (Table II). However, there were minimal differences between different levels of persistent severity (Table II).

How care is delivered and by whom influences anti-inflammatory use (Table III). At all levels of asthma symptoms, persons who reported having been seen by

**TABLE II.** Persons within each short-term asthma symptom category who reported current use of any anti-inflammatory medication or the use of greater than 4 canisters of reliever medication during the past year

| Medication category   | Short-term symptom burden       |                              |                                  |                                |                     |
|-----------------------|---------------------------------|------------------------------|----------------------------------|--------------------------------|---------------------|
|                       | Mild intermittent<br>(n = 1234) | Mild persistent<br>(n = 487) | Moderate persistent<br>(n = 323) | Severe persistent<br>(n = 465) | Total<br>(n = 2509) |
| Anti-inflammatory (%) | 14*                             | 26                           | 23                               | 29                             | 20                  |
| Reliever >4 (%)       | 13*                             | 34                           | 46                               | 48                             | 28                  |

\* $P < .01$  for difference between intermittent and persistent asthma.

**TABLE III.** Frequency (%) of anti-inflammatory medication use among persons according to variables related to the pattern of care delivery stratified by short-term asthma symptoms

| Category                                   | Short-term symptom burden       |                              |                                  |                                |                     |
|--------------------------------------------|---------------------------------|------------------------------|----------------------------------|--------------------------------|---------------------|
|                                            | Mild intermittent<br>(n = 1234) | Mild persistent<br>(n = 487) | Moderate persistent<br>(n = 323) | Severe persistent<br>(n = 465) | Total<br>(n = 2509) |
| Type of physician seen for asthma          |                                 |                              |                                  |                                |                     |
| Specialist (n = 564)                       | 68 (24)                         | 48 (41)                      | 29 (37)                          | 40 (36)                        | 185 (33)*           |
| Other (n = 1854)                           | 98 (11)                         | 76 (22)                      | 45 (19)                          | 93 (28)                        | 312 (17)            |
| Have scheduled follow-up visits for asthma |                                 |                              |                                  |                                |                     |
| Yes (n = 1379)                             | 109 (18)                        | 89 (31)                      | 51 (26)                          | 101 (33)                       | 350 (25)*           |
| Only with problems (n = 1067)              | 64 (10)                         | 37 (19)                      | 20 (18)                          | 32 (22)                        | 153 (15)            |
| Written asthma action plan                 |                                 |                              |                                  |                                |                     |
| Yes (n = 673)                              | 82 (25)                         | 41 (33)                      | 30 (31)                          | 54 (39)                        | 207 (30)*           |
| No (n = 1625)                              | 83 (10)                         | 77 (24)                      | 37 (19)                          | 65 (23)                        | 262 (16)            |

\* $P < .001$ .

pulmonologists or allergists for their asthma were significantly ( $P < .001$ ) more likely to report current use of anti-inflammatory medication than were those managed by other types of clinicians. Persons who reported regular scheduled visits for asthma were significantly ( $P < .001$ ) more likely to use anti-inflammatory medication than were those who visited their physician only when they had problems. Having a written action plan with self-treatment guidelines also was associated with significantly ( $P < .001$ ) greater reported use of anti-inflammatory medication across severity categories.

The relationship of the subjects with their physicians also influenced medication use. Subjects who rated their physician more highly in terms of a number of specific patient-physician interaction characteristics (Table IV), including ability to explain asthma management ( $P < .001$ ), willingness to spend time with the patient ( $P = .029$ ), and encouragement to participate in treatment decisions ( $P = .017$ ), reported anti-inflammatory medication use significantly more often than did those with less favorable ratings of their physician's behavior.

Insurance status was also found to be associated with asthma medication use. Subjects who reported having health insurance were more likely to report anti-inflammatory medication use than were those without insurance ( $P < .001$ , Table V). However, among those with

health insurance, the extent of the coverage of costs provided by insurance for physician visits or pharmaceuticals did not affect the frequency of reported anti-inflammatory medication use. In addition, persons with Medicaid reported less anti-inflammatory medication use than did those with private insurance or Medicare ( $P = .001$ ).

In a multiple logistic regression model controlling for socioeconomic status, demographic variables, and asthma symptom burden (Table VI), reported anti-inflammatory medication use was significantly associated with a number of variables related to the delivery of care for asthma. Patients reporting their physician having an excellent or very good ability to explain asthma management were 47% more likely to report anti-inflammatory medication use (odds ratio [OR], 1.47; 95% CI, 1.3-2.3). Those with a written asthma action plan were 63% more likely (OR, 1.63; 95% CI, 1.3-2.1), and those reporting scheduling regular visits to see a physician for asthma were 30% more likely to report use of anti-inflammatory medication (OR, 1.30; 95% CI, 1.0-1.4). There were also significant associations seen with a number of variables related to asthma morbidity and severity and with race/ethnicity and smoking. Short-term symptoms, income, education, place of residence, and insurance status were not significantly associated with reported anti-inflammatory medication use in the multivariate model.

**TABLE IV.** Frequency (%) of anti-inflammatory medication use among persons according to variables related to the physician behavior in consultations stratified by short-term asthma symptoms

| Category                                                   | Short-term symptom burden       |                              |                                  |                                |                     |
|------------------------------------------------------------|---------------------------------|------------------------------|----------------------------------|--------------------------------|---------------------|
|                                                            | Mild intermittent<br>(n = 1234) | Mild persistent<br>(n = 487) | Moderate persistent<br>(n = 323) | Severe persistent<br>(n = 465) | Total<br>(n = 2509) |
| Rate physician on ability to explain asthma management     |                                 |                              |                                  |                                |                     |
| Excellent/very good (n = 1782)                             | 141 (15)                        | 98 (29)                      | 61 (28)                          | 105 (34)                       | 395 (22)*           |
| Good/fair/poor (n = 641)                                   | 30 (11)                         | 28 (22)                      | 11 (11)                          | 27 (19)                        | 96 (15)             |
| Rate physician on willingness to spend time with you       |                                 |                              |                                  |                                |                     |
| Excellent/very good (n = 1817)                             | 136 (14)                        | 93 (29)                      | 64 (30)                          | 102 (31)                       | 395 (22)†           |
| Good/fair/poor (n = 633)                                   | 37 (14)                         | 33 (21)                      | 8 (9)                            | 31 (25)                        | 109 (17)            |
| Rate physician on time spent with you                      |                                 |                              |                                  |                                |                     |
| Excellent/very good (n = 1734)                             | 131 (14)                        | 92 (30)                      | 62 (29)                          | 92 (30)                        | 377 (22)            |
| Good/fair/poor (n = 719)                                   | 42 (14)                         | 34 (21)                      | 10 (11)                          | 41 (27)                        | 127 (17)            |
| Extent you participate in treatment decisions about asthma |                                 |                              |                                  |                                |                     |
| A lot/some (n = 2095)                                      | 148 (14)                        | 116 (28)                     | 67 (24)                          | 112 (30)                       | 443 (21)‡           |
| Not much/not at all (n = 382)                              | 23 (12)                         | 10 (14)                      | 5 (13)                           | 22 (27)                        | 60 (16)             |

\* $P < .001$ .† $P = .029$ .‡ $P = .017$ .**TABLE V.** Frequency (%) of anti-inflammatory use among persons in various categories of health insurance coverage stratified by short-term symptoms

| Category                                      | Short-term symptom burden       |                              |                                  |                                |                     |
|-----------------------------------------------|---------------------------------|------------------------------|----------------------------------|--------------------------------|---------------------|
|                                               | Mild intermittent<br>(n = 1234) | Mild persistent<br>(n = 487) | Moderate persistent<br>(n = 323) | Severe persistent<br>(n = 465) | Total<br>(n = 2509) |
| Any health insurance                          |                                 |                              |                                  |                                |                     |
| Yes (n = 2172)                                | 160 (15)                        | 115 (27)                     | 88 (25)                          | 120 (31)                       | 463 (21)*           |
| No (n = 311)                                  | 13 (8)                          | 11 (20)                      | 3 (7)                            | 14 (18)                        | 41 (13)             |
| Type of health insurance                      |                                 |                              |                                  |                                |                     |
| Private (n = 1677)                            | 133 (15)                        | 102 (29)                     | 52 (25)                          | 85 (34)                        | 372 (22)            |
| Medicare (n = 216)                            | 16 (22)                         | 10 (31)                      | 11 (29)                          | 16 (26)                        | 53 (26)             |
| Medicaid (n = 196)                            | 7 (9)                           | 1 (3)                        | 4 (15)                           | 11 (19)                        | 23 (11)*            |
| How much insurance pays for physician visits† |                                 |                              |                                  |                                |                     |
| All/most (n = 1849)                           | 135 (14)                        | 103 (28)                     | 58 (24)                          | 104 (33)                       | 399 (22)            |
| Some/none (n = 278)                           | 23 (17)                         | 12 (22)                      | 11 (28)                          | 14 (26)                        | 60 (21)             |
| How much insurance pays for drugs†            |                                 |                              |                                  |                                |                     |
| All/most (n = 1680)                           | 116 (14)                        | 93 (27)                      | 54 (25)                          | 91 (32)                        | 354 (21)            |
| Some/none (n = 451)                           | 42 (18)                         | 22 (28)                      | 14 (24)                          | 27 (30)                        | 105 (23)            |

\* $P < .001$ .

†Among those with health insurance.

## DISCUSSION

Our results from a representative national sample of persons with asthma indicates that how asthma care is organized and by whom it is delivered are important fac-

tors influencing appropriate use of anti-inflammatory medication. Our results suggest areas where opportunities exist to improve use of anti-inflammatory therapy.

How care is delivered and by whom influences anti-inflammatory medication use. Scheduling regular visits

**TABLE VI.** Multiple logistic regression for reported use of anti-inflammatory medication for asthma in the past 4 weeks

| Variable                                                           | OR   | 95% CI    |
|--------------------------------------------------------------------|------|-----------|
| Younger age                                                        | 0.82 | 0.73-0.94 |
| White, non-Hispanic ethnicity                                      | 1.53 | 1.19-1.98 |
| Smoker                                                             | 0.50 | 0.37-0.68 |
| Schedule regular follow-up visits for asthma with physician        | 1.30 | 1.02-1.64 |
| Possess written asthma action plan                                 | 1.63 | 1.29-2.06 |
| Rate physician with excellent ability to explain asthma management | 1.47 | 1.09-1.98 |
| Less long-term effect burden from asthma                           | 0.82 | 0.71-0.94 |
| Less than 4 canisters of reliever medications used in past year    | 0.50 | 0.43-0.58 |
| Miss $\geq 5$ days from usual activities in past year from asthma  | 1.29 | 1.01-1.65 |
| Hospital admission past year for asthma                            | 1.74 | 1.19-2.53 |

with a physician for asthma is independently associated with increases in appropriate anti-inflammatory medication use across severity levels. Patients managed by clinicians with a special interest in and knowledge of asthma have better outcomes,<sup>6,7</sup> and it is likely that better use of preventive medication<sup>7</sup> and the scheduling of regular follow-up visits for review by a physician<sup>17,18</sup> are important factors in this.

Also, the quality of physician-patient interactions might also increase appropriate anti-inflammatory medication use. Increased use of written action plans and more positive interactions in terms of willingness of physicians to spend time with and explain asthma management to patients appears to be associated with increased anti-inflammatory medication use in those for whom it is indicated, independent of the level of asthma symptoms. It is likely that improved patient adherence with prescribed therapy is a key factor. Apter et al<sup>19</sup> found that persons who reported impediments to communication with their physician also showed reduced adherence to inhaled steroid regimens. Patients modify their adherence with medical regimens to accommodate the social, psychologic, economic, and physical influences on their lives.<sup>20-22</sup> The process of assisting patients with this is more than a simple educational task.<sup>23</sup> Clark and Gong<sup>24</sup> argue that neither patients nor physicians are adequately taught the skills needed to fulfil their role and responsibility for asthma management. Proven strategies exist to help improve communication and patient education about asthma.<sup>25</sup> A focus on improving effective patient communication to enhance adherence to therapy through dissemination of a guide to health professionals<sup>26</sup> or specific training<sup>27</sup> might be a starting point.

In bivariate analysis, having health insurance was associated with increased reported anti-inflammatory medication use. It is interesting that the proportion of physician visits and drug costs reputedly covered by insurance for those who had insurance did not appear to influence anti-inflammatory medication use. It is possible that these findings reflect the relationship between stable employment and other socioeconomic advantages and possession of health insurance. It might be that these factors are the drivers of medication use rather than insurance per se. However, socioeconomic status has not consistently been a strong, independent factor associated

with medication adherence in previous studies.<sup>28,29</sup> Another possibility is that persons with health insurance making regular visits to physicians are more likely to receive free medication samples, thus reducing their health care expenses. One possible implication from our findings is that, at least for asthma treatment, initial efforts should be directed toward ensuring greater coverage rather than trying to optimize drug benefits and patient cost-sharing arrangements.

Our study is limited by the use of self-report data only. Only individuals who identified themselves as having asthma were included. However, this is an appropriate measure when investigating medication use or health service use.<sup>30</sup> Persons tend to overreport use of inhaled medications,<sup>31</sup> and this might affect our findings. It has not been consistently shown that certain groups are more likely to exhibit this tendency and hence introduce systematic bias.<sup>28,29,32</sup> In addition, no objective measure of lung function was available for use in severity categorization. However, the strength of this study is the detailed amount of information of symptom data available at the individual level to determine the appropriate use of therapy. Recall bias might also have influenced our findings, but this is likely to have been limited by the time period for recalling symptoms and medication use to the previous 4 weeks. We did not directly observe the interaction between patients and physicians during consultations. However, previous work has shown a significant correlation between survey reports of physicians adopting a participatory decision-making style and direct observation of behavior in consultations.<sup>33</sup> Furthermore, it can be argued that patients' perceptions are the only criterion by which physician efforts in this area can usefully be judged. The cross-sectional nature of this study limits our ability to assert causal links for the associations found with asthma medication use. However, the consistency of the results with the findings of studies in selected populations provides confidence in the validity of our conclusions.

Although our survey was limited to households with telephones, 94.1% of occupied housing units in the United States had telephone service in 1998 (Federal Communications Commission, Trends in Telephone Service, July 1999). Our study population is representative of the US population. Recent US census figures for the general

population report a distribution of race and education level similar to that of our asthma population. In addition, our findings indicated that socially disadvantaged groups were less likely to report currently using anti-inflammatory medications. Hence any bias in sampling by only using households with telephone service that underrepresents minority or poor households will tend to underestimate the extent of this problem.

Expanding access to regular, scheduled follow-up care by physicians with an interest in asthma might be cost-effective for managing asthma, and further research examining this question is warranted. Efforts to improve asthma education and patient-physician communication should seek to incorporate the results of behavioral research more effectively than is done at present. Adopting an approach to asthma management that includes these ideas might lead to increased use of appropriate therapies and improved outcomes for patients with asthma.

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