

# The Impact of Allergies and Allergy Treatment on Worker Productivity

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*Allergic disorders are a chronic and highly prevalent condition in the general population and the workforce. Their effect on workers and corporate costs go beyond the direct cost of treatment, as the condition can lower a worker's productivity. Previous research includes estimates of the decrease in productivity associated with allergic disorders. None of these studies, however, offered an objective measure of how worker productivity is affected by allergic disorders. In the present study, the productivity of telephone customer service representatives suffering from allergic disorders is examined before, during, and after the ragweed pollen season. In addition, these workers were surveyed as to the type of medication they used in response to their condition. A significant correlation was observed between an increase in pollen counts and a decrease in productivity for workers with allergies. Compared with workers without allergies, employees with allergies who reported using no medication showed a 10% decrease in productivity. No differences were observed among workers with allergies using different types of medications, although the medication groups had significantly higher productivity than the no-medication group. The expected lowered productivity of those workers with allergies who used sedating antihistamines may have been offset by their relatively lower level of symptom severity and by the nature of the job and the productivity measures used. (J Occup Environ Med. 2001;43:64–71)*

An estimated 15 to 39 million people in the United States suffer with allergic disorders (AD) either seasonally or perennially,<sup>1–4</sup> and the chronic condition is responsible for approximately 9 to 10 million visits to physicians' offices every year.<sup>5,6</sup> Given their substantial prevalence in the general population, AD are also common in the American workforce. It is estimated that about 12% of American working women and 10% of working men suffer from AD.<sup>7</sup> These roughly 13 million workplace sufferers make AD as prevalent as more commonly recognized conditions, including back pain and hypertension.<sup>7–9</sup>

That AD should be a significant driver of both direct and indirect health care costs is not surprising. The symptoms of the condition may include itching and irritation of the nose; copious watery nasal discharge; nasal congestion; paroxysmal sneezing; and itching of the eyes, ears, and palate. These symptoms are frequently accompanied by generalized systemic manifestations, including fatigue, weakness, malaise, irritability, and decreased appetite. A study comparing the quality of life between AD patients and controls found significantly lower scores for the allergy patients on measures such as social functioning, role limitation, mental health, energy/fatigue, and pain.<sup>10</sup> Direct costs, such as physician visits, prescription and over-the-counter (OTC) medications, and environmental controls (eg, air filters) have been estimated as high as \$4.5 billion.<sup>11</sup> Nationally, AD accounts for approximately 0.2% of total med-

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ical expenditures and 3% of all respiratory expenditures.<sup>1,12</sup>

The indirect costs associated with an illness prove more difficult to quantify because they represent the diminished productivity resulting from the illness. The most visible components of the total indirect cost array would be lost workdays due to a worker's being too ill to function and/or the disability costs connected to the illness. With regard to AD, one estimate holds that 3.5 million workdays may be lost annually because of allergies.<sup>12</sup> In a study in which patients self-reported the impact of AD on their lives, one quarter of them reported missing some work or school because of allergy symptoms in the 7 days preceding their baseline assessment.<sup>13</sup>

The productivity loss connected to AD also includes a more insidious component than the absence from work. More likely than absence is the circumstance of workers being present at work but limited in their daily productivity because of the symptoms of AD. Ironically, treatment for AD may further diminish productivity. Older, first-generation antihistamines, and many OTC remedies, are known to produce drowsiness and to impair cognitive and motor function.<sup>14-17</sup> One study projected that the use of sedating antihistamines by affected workers could result in a 25% reduction in productivity for 2 weeks per year and a cost to US corporations and society of as much as \$2.8 billion per year. This estimation did not include the additional cost of 1 lost workday per year due to AD, which if included, would raise the estimate by an additional \$108 to \$324 million.<sup>7</sup>

Investigations of the effect of first-generation, sedating antihistamines have shown their negative impact on the performance of everyday tasks to be substantial. One study found that workers using sedating antihistamines had a 50% higher risk of on-the-job injury than control subjects.<sup>18</sup> Another study found that driving impairment connected with a

sedating antihistamine was worse than that connected with a blood-alcohol concentration of 0.1%.<sup>19</sup>

Although the cost-of-illness studies projected the impact of allergies and their treatment, few if any included actual measures of productivity. Thus, these previous studies are estimates based on hypothetical assumptions of the extent of disruption that AD may have on workers' performance. One study examined the actual productivity output of claims processors at a large insurance company.<sup>20</sup> By identifying the date that an employee filled a prescription for an antihistamine, these investigators were able to track the employee's actual daily output of processed claims over the following week. They compared this output with the employee's previous average daily output. Overall, the productivity of workers taking a sedating antihistamine was about 12% below that of workers taking non-sedating antihistamines. There were drawbacks to this study, including the possibilities that the prescribed antihistamine may not have been taken or that the drug may have been prescribed for a member of the employee's family rather than the employee. Furthermore, no measure of AD severity and no correlated observation of pollen counts were included.

In the current study, telephone customer service representatives were surveyed as to whether they suffered from AD, and if so, the perceived severity of their AD condition and the medication they chose in response. Actual productivity data were then examined in correlation with pollen counts in an effort to determine the amount of productivity impairment connected with AD and its treatment. In this way, real productivity impairment related to AD was linked to seasonal variations in pollen allergens and to medication options.

## Method

### The Worksite

First Card is the fifth largest credit card issuer in the United States and a

wholly owned subsidiary of a major financial services corporation, First Chicago NBD Corporation (FC-NBD). (In October 1998, FCNBD merged with Banc One to form a new corporation, Bank One.) The parent corporation is the fourth largest bank holding corporation in the United States. First Card has a large operations, marketing, and service center in Elgin, Illinois, that opened in 1991 and employs approximately 3000 people. Approximately 72% of the employees are female.

### Participants and the Survey

At the end of June 1998, a total of 1600 telephone customer service operators at Elgin First Card received initial surveys and flyers regarding the project. The flyers explained the intention of the survey, invited the employee to a 45-minute seminar on allergies and their treatments, and offered an incentive for completion of the survey and attendance at the seminar. The seminar was offered by the on-site Health and Wellness Unit, which was also listed as a survey sponsor in conjunction with the University of Michigan's Health Management Research Center. The on-site Health and Wellness unit is one of eight such units representing FC-NBD's Corporate Medical Department at similar large employee sites. The units are staffed by occupational health nurses and Employee Assistance Program professionals.

The survey asked the employees if they suffered from hay fever/allergies, asthma, or nasal allergies. It also asked the employees to indicate, from a list, what medications they were currently taking for their allergies. The list contained non-prescription/OTC medications and prescription medications. Other questions on the survey included the self-rating of symptom severity and quality-of-life indicators, such as related sleep difficulties and emotional functioning.

Of the 1600 initial surveys distributed, 866 (54%) were completed and returned. Previous research at this worksite<sup>21</sup> revealed that the tele-

phone customer service representatives required at least 13 weeks of experience before mastering the learning curve of the job and showing reliable and consistent productivity. Consequently, survey respondents with less than 6 months of experience were excluded from the study, reducing the sample to 741. Next, 107 respondents who reported having asthma were excluded. The final study population of 634 included 327 employees with reported allergy symptoms and 307 without.

A second survey was sent to participants in late fall (October 30, 1998). This survey was identical to the initial survey and another incentive (a windbreaker with the corporate logo) was offered for its completion and return. The follow-up survey was completed and returned by 459 (72%) study participants. For the participants who did not return the second survey, data from their initial survey were used in the analysis. Comparisons between the al-

lergy and non-allergy groups revealed no demographic differences (Table 1), nor were any observed between the study population as a whole and those employees who did not participate in the program.

The self-reported data on type of medication use revealed that 71 of the 327 employees in the allergy group used no medication. The remainder of this group contained 30 who used only nasal medications, 125 who used only sedating antihistamines (either OTC or prescription), 51 who used only non-sedating antihistamines, and 50 who used both sedating and non-sedating antihistamines. Analyzing this same group by the primary source of their medication rather than the type revealed that of the 327 employees, 136 purchased their medications OTC without a prescription, 120 used prescription medications, and 71 reported using no medication.

In addition to the demographic and medication information on the sub-

jects, Health Risk Appraisal (HRA) information was available for virtually all participants. These data, along with the demographic information, are maintained in the Corporate Medical Department's OMNI health data warehouse.<sup>22</sup> The Health Risk Appraisal is composed of approximately 40 questions (the exact number of questions varies by follow-up questions to certain affirmative responses) and is offered to employees on a voluntary basis at the time of hire and periodically during their employment tenure. The version used in this study was the developed by the University of Michigan Health Management Research Center and the Bank One Medical Unit. The questions on the Health Risk Appraisal concern physical characteristics (eg, weight and height), behaviors (eg, cigarette smoking, using seat belts), family and individual medical history, and life experiences that may predispose a person to illness. In the study population, 299 in

**TABLE 1**  
Allergy Seminar Participants and Non-Participants

|                           | Non-Participants<br>(n = 1021) |       | Participants<br>Without Allergy<br>(n = 307) |       | Participants<br>With Allergy<br>(n = 327) |       | Chi-Squared<br>or t Test*<br>(P) |
|---------------------------|--------------------------------|-------|----------------------------------------------|-------|-------------------------------------------|-------|----------------------------------|
|                           | n                              | %     | n                                            | %     | n                                         | %     |                                  |
| Gender                    |                                |       |                                              |       |                                           |       |                                  |
| Male                      | 177                            | 17.30 | 34                                           | 11.10 | 38                                        | 11.60 | 0.829                            |
| Female                    | 844                            | 82.70 | 273                                          | 88.90 | 289                                       | 88.40 |                                  |
| Age                       |                                |       |                                              |       |                                           |       |                                  |
| <25                       | 216                            | 21.20 | 74                                           | 24.10 | 56                                        | 17.10 | 0.148                            |
| 25-34                     | 323                            | 31.60 | 102                                          | 33.20 | 127                                       | 38.80 |                                  |
| 35-44                     | 273                            | 26.70 | 69                                           | 22.50 | 79                                        | 24.20 |                                  |
| 45+                       | 209                            | 20.50 | 62                                           | 20.20 | 65                                        | 19.90 |                                  |
| Average age (end of 1998) | 34.6                           |       | 34.7                                         |       | 35                                        |       | 0.093                            |
| Ethnicity                 |                                |       |                                              |       |                                           |       |                                  |
| Asian                     | 18                             | 1.80  | 6                                            | 2.00  | 9                                         | 2.80  | 0.602                            |
| Black                     | 119                            | 11.70 | 26                                           | 8.50  | 23                                        | 7.00  |                                  |
| Caucasian                 | 798                            | 78.20 | 246                                          | 80.10 | 270                                       | 82.60 |                                  |
| Hispanic                  | 83                             | 8.10  | 29                                           | 9.40  | 24                                        | 7.30  |                                  |
| Native American           | 3                              | 0.30  | 0                                            | 0.00  | 1                                         | 0.30  |                                  |
| Employment type           |                                |       |                                              |       |                                           |       |                                  |
| Full-Time                 | 730                            | 71.50 | 220                                          | 71.70 | 244                                       | 74.60 | 0.401                            |
| Part-time                 | 291                            | 28.50 | 87                                           | 28.30 | 83                                        | 25.40 |                                  |
| Employment Length         |                                |       |                                              |       |                                           |       |                                  |
| 6 months to 1 year        | 104                            | 10.20 | 30                                           | 9.80  | 18                                        | 5.50  | 0.112                            |
| 1-4 years                 | 596                            | 58.40 | 205                                          | 66.80 | 223                                       | 68.20 |                                  |
| 5+ years                  | 321                            | 31.40 | 72                                           | 23.50 | 86                                        | 26.30 |                                  |

\* Testing for significant differences between participants with allergies and without allergies.

the allergy group and 269 in the non-allergy group had HRA data available. Employees in the allergy group were found to have a significantly higher average number of health risks than the non-allergy group ( $P = 0.028$ ) (Table 2). In particular, the allergy group reported a significantly higher use of relaxation medicine ( $P = 0.001$ ), significantly lower life satisfaction ratings ( $P = 0.007$ ), and significantly higher stress ratings ( $P = 0.004$ ).

## Productivity Measurement

The telephone customer service job and corresponding productivity measurement system used in this study have been described in detail in an earlier report.<sup>21</sup> The computer-

ized productivity measurement system tracks the number of calls received and answered, along with time variables connected to the job tasks of telephone customer service including talk time per call, transfer/hold time, time for after-call work, total unavailable time, and total time staffed at the workstation. In general, customer service jobs that handle customer inquiries usually have as their goal the provision of accurate and helpful information in the shortest time possible so as to minimize delay for other waiting customers.

Of the variables measured by the computerized productivity measurement system, two were selected for their universality across the various subgroups of telephone customer

service representatives. The first of these was handle time per call ("handle time"), which was the sum of talk time, transfer or hold time, and the time for after-call work for each answered phone call. The other productivity measure selected was the amount of auxiliary time ("aux time"), the time during which the employee was unavailable to receive phone calls at the workstation during the workday. Both measures reflect higher productivity when their values are lower.

Setting the productivity standard for these variables was done in the same manner as in the earlier referenced study. A total of 89,893 weekly productivity logs of 1762 customer service representatives

**TABLE 2**  
Health Risks\*

|                                   | All With HRA |       | No Allergy |      | With Allergy |      | Chi-Squared<br>or <i>t</i> Test ( <i>P</i> ) |
|-----------------------------------|--------------|-------|------------|------|--------------|------|----------------------------------------------|
|                                   | <i>n</i>     | %     | <i>n</i>   | %    | <i>n</i>     | %    |                                              |
| Total with HRA                    | 668          | 100.0 | 269        | 40.3 | 299          | 44.8 |                                              |
| Lifestyle                         |              |       |            |      |              |      |                                              |
| Current smokers                   | 177          | 26.5  | 79         | 29.4 | 77           | 25.8 | 0.335                                        |
| Physical activities (<1/wk)       | 184          | 27.5  | 81         | 30.1 | 78           | 26.1 | 0.286                                        |
| Seat belt use <90%                | 145          | 21.7  | 62         | 23.0 | 59           | 19.7 | 0.335                                        |
| Alcoholic drinks >14/wk           | 3            | 0.4   | 1          | 0.4  | 1            | 0.3  | 0.940                                        |
| Use relaxation medicine           | 169          | 25.3  | 47         | 17.5 | 89           | 29.8 | 0.001 <sup>†</sup>                           |
| Perception                        |              |       |            |      |              |      |                                              |
| Low life satisfaction             | 167          | 25.0  | 52         | 19.3 | 87           | 29.1 | 0.007 <sup>†</sup>                           |
| Poor physical health              | 97           | 14.5  | 31         | 11.5 | 48           | 16.1 | 0.119                                        |
| Low job satisfaction <sup>‡</sup> | 162          | 24.3  | 60         | 22.3 | 71           | 23.7 | 0.684                                        |
| High stress (score >18)           | 238          | 35.6  | 79         | 29.4 | 122          | 40.8 | 0.004 <sup>†</sup>                           |
| Biological risks                  |              |       |            |      |              |      |                                              |
| Existing medical problems         | 61           | 9.1   | 16         | 5.9  | 27           | 9.0  | 0.166                                        |
| Heart disease                     | 12           | 1.8   | 4          | 1.5  | 5            | 1.7  | 0.860                                        |
| Diabetes                          | 21           | 3.1   | 7          | 2.6  | 11           | 3.7  | 0.465                                        |
| Lung disease                      | 34           | 5.1   | 7          | 2.6  | 12           | 4.0  | 0.350                                        |
| Asthma <sup>‡</sup>               | 84           | 12.6  | 0          | 0.0  | 2            | 0.7  | 0.179                                        |
| Back pain <sup>‡</sup>            | 256          | 38.3  | 89         | 33.1 | 121          | 40.5 | 0.069                                        |
| Migraine <sup>‡</sup>             | 199          | 29.8  | 64         | 23.8 | 101          | 33.8 | 0.009 <sup>†</sup>                           |
| High blood pressure               | 79           | 11.8  | 30         | 11.2 | 42           | 14.0 | 0.301                                        |
| Cholesterol                       | 34           | 5.1   | 8          | 3.0  | 21           | 7.0  | 0.029 <sup>§</sup>                           |
| BMI at risk <sup>  </sup>         | 251          | 37.6  | 95         | 35.3 | 118          | 39.5 | 0.308                                        |
| Overall health risks              |              |       |            |      |              |      |                                              |
| 0–2 risk factors                  | 364          | 54.5  | 160        | 59.5 | 155          | 51.8 |                                              |
| 3–4 risk factors                  | 181          | 27.1  | 72         | 26.8 | 81           | 27.1 |                                              |
| 5+ risk factors                   | 123          | 18.4  | 37         | 13.8 | 63           | 21.1 | 0.022 <sup>§</sup>                           |
| Average no. of risks              | 2.65         |       | 2.38       |      | 2.81         |      | 0.028 <sup>§</sup>                           |

\* HRA, Health Risk Appraisal; BMI, body mass index.

<sup>†</sup>  $P < 0.01$ .

<sup>‡</sup> Not included in risk calculation.

<sup>§</sup>  $P < 0.05$ .

<sup>||</sup> Male  $\geq 27.8$ ; female  $\geq 27.3$ .

who had worked 6 months or longer between January 1, 1998, and March 31, 1999, were used to establish the handle time and aux rate standards for each department. As in the previous study, the productivity standard for handle time was set at the 75th percentile of the range of average handle time scores. The productivity standard for the aux rate was again set at the 90th percentile of the associated range of scores.

The 634 employees in the study produced 28,584 weekly productivity records corresponding to the study period. Each week, each employee was classified as either meeting the overall productivity standard or not. This determination was accomplished in a series of steps. First, each employee's weekly handle time and aux rate average was compared with his or her department's handle time and aux rate productivity standard. A binomial productivity score was then assigned to each employee's weekly performance, either a 1 or a 0. The 1 indicated that the productivity standard was achieved and the 0 indicated that it had not been achieved. If the employee had worked in more than one department during a given week, a separate handle time achievement score and aux rate achievement score were calculated for each department. In this case, an average was then calculated of all of the employee's handle time achievement scores and, similarly, of all of the employee's aux rate achievement scores for the week. The total weekly score was then assigned a 1 if both the handle time achievement score and the aux rate achievement score were greater than or equal to 0.5, and a 0 otherwise. Both the handle time achievement score and the aux rate achievement score were adjusted for age, full-time versus part-time status, and hours worked per week. Finally, the overall score for each employee was compiled by taking the average of all weekly scores. If this average was greater than or equal to 0.5, the

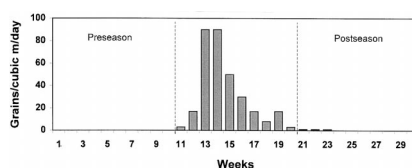


Fig. 1. Average weekly pollen counts.

employee was classified as meeting the productivity standard.

### Pollen Count Measurement

Surveillance Data Inc provided daily pollen counts for a period beginning May 25 through November 16, 1998, from collection stations located in Elgin, Illinois, and another nearby community. Data were gathered for this length of time to ensure that the study would capture the peak fall ragweed season in the Midwest and a period of time before and after the season. Average weekly pollen counts in terms of grains per cubic meter per day were calculated; this provided the basis for categorizing each week as Absent (0), Low (0 to 10), Medium (>10 to 50), or High (>50) (Figs. 1 and 2). These categories corresponded to the suggested definitions by the American Academy of Allergy, Asthma and Immunology, and the National Allergy Bureau. Using these ratings led to a classification of a 10-week ragweed season from August 3 to October 5, 1998. A corresponding 10-week, pre-season baseline period was established from May 25 to July 27, 1998, and a 10-week, post-season follow-up period was established from October 12 to December 14, 1998. The 10-week post-season period had pollen counts available for the first 5 weeks of the period only, because pollen measurement stops with the beginning of winter in the Midwest. It was assumed that the pollen count for the final 5 weeks of the post-season period was zero.

## Results

### Pollen Levels and Productivity

A chi-squared analysis revealed that as pollen levels increased, the

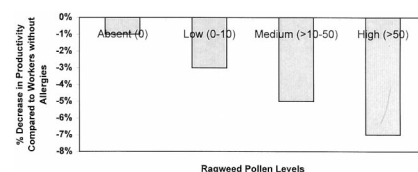


Fig. 2. Effect of ragweed pollen levels on workers with allergies.

productivity of employees with allergies decreased significantly ( $P$  for trend = 0.0464) (Table 3 and Fig. 2). Employees with allergies showed a significant reduction in productivity between weeks in which the pollen count was absent and weeks in which the pollen count was rated as high ( $P = 0.0213$ ). During those weeks in which the pollen count was rated as high, employees with allergies were 7% less likely to attain the productivity standard than their counterparts without allergies (Fig. 3).

Analyzing these same data in terms of the 10-week study periods revealed that during the ragweed season (August 3 to October 5, 1998), employees with allergies were significantly less likely than employees without allergies to attain the productivity standards ( $P = 0.009$ ) (Table 4). No significant difference was observed between the allergy and non-allergy groups in the periods before or after the ragweed season. Compared with employees without allergies, those having allergies were 5% less likely to attain the productivity standard during the 10-week ragweed season (Fig. 3).

### Symptom Severity and Medication Use

Employees in the allergy group showed a significant relationship between their self-reported symptom severity and the type of medication used. For analyses regarding the impact of medication, the various types of medications were combined into three groups: no medication, sedating antihistamines, and non-sedating medications. The sedating-antihistamines group contained the employees who reported using only sedating

**TABLE 3**  
Percent Meeting Weekly Productivity Standard

|                                                      | No Allergy<br>(n = 307) | With Allergy<br>(n = 327) | Chi-Squared<br>(P) |
|------------------------------------------------------|-------------------------|---------------------------|--------------------|
| Ragweed pollen level (%)                             |                         |                           |                    |
| Absent (0)                                           | 71.40                   | 70.40                     | 0.6275             |
| Low (0–10)                                           | 72.70                   | 70.20                     | 0.1471             |
| Medium (>10–50)                                      | 70.50                   | 67.10                     | 0.1097             |
| High (>50)                                           | 70.10                   | 65.50                     | 0.0569             |
| Chi-squared P for interaction<br>among pollen levels | 0.5638                  | 0.0464*                   |                    |

\*  $P < 0.05$ .

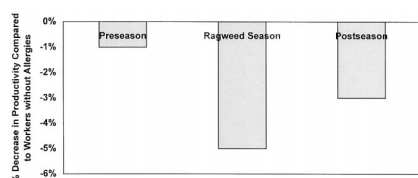


**Fig. 3.** Effect of ragweed season on workers with allergies.

antihistamines and those who reported using both sedating and non-sedating antihistamines. Thus the members of this group all reported some use of sedating antihistamines. As Table 5 reveals, those employees who rated their symptoms as mild were most likely to report the use of no medication. Employees who characterized their allergy symptoms as moderate or severe were significantly more likely to make use of non-sedating antihistamines ( $P = 0.018$ ).

## Medication Type and Productivity

Differences in productivity associated with different types of allergy medication were analyzed for all three 10-week periods of the study (August 3 to October 5, 1998). No differences were observed in performance between the allergy and non-allergy groups in the pre- and post-season periods. Nevertheless, a chi-squared analysis revealed that the employees in the allergy group who reported using no medication were significantly less likely to meet the productivity standard during the ragweed season (Table 6). Little dif-

ference was observed between employees who used non-sedating and sedating antihistamines during this period.

Compared with employees without allergies, those who reported using no medication were 10% less productive during ragweed season. Employees who reported using non-sedating antihistamines and those who reported using sedating antihistamines showed a 3% reduction in productivity compared with employees without allergies.

Examining the same data by means of multivariate logistic regression allowed us to control for possible mediating variables. Table 7 displays the odds ratios connected with the various groups and reflects the data adjusted for gender, age, work experience, and the number of health risks. It can be seen that during ragweed season, the odds of meeting the standards for both handle time and aux rates were significantly lower for the allergy group in general (odds ratio, 0.74;  $P \leq 0.0001$ ), and for each of the medication subgroups. Once again, the workers with allergies who reported using no medication performed the poorest; compared with workers without allergies, employees in this group were 33% less likely to attain the productivity standard (odds ratio, 0.67;  $P \leq 0.0001$ ).

## Discussion

This study demonstrates that compared with workers without allergies, employees who suffer from allergies

show a significant decrease in their productivity as pollen levels increase. For employees who report using no medication to treat their allergic condition, productivity may be lowered as much as 10% compared with that of their coworkers without allergies during the peak pollen seasons. Considering that the average daily compensation (wages plus benefits) for employees in this study is \$104, a 10% reduction in weekly productivity amounts to a loss of \$52 per week per affected employee. In this study's allergy group, 22% of the employees affected with allergies reported using no medication. Given the common prevalence of AD, such a ratio of non-medication use would have substantial implications for lost productivity among the general population of workers with allergies.

In this study, little difference was observed in the productivity of employees who used sedating versus non-sedating antihistamines, although both groups showed higher productivity than employees who used no medication. Three reasons may account for this lack of an observed difference. First, those employees who reported using non-sedating antihistamines were significantly more likely to characterize their symptoms as severe. Therefore, in this study, those with the worst allergy symptoms were more likely to use non-sedating medications, whereas those who characterized their symptoms as less troublesome opted for sedating antihistamines or no medication at all. Thus, the productivity impairment associated with the sedating antihistamines may have been offset by the relatively lower symptom impairment of that group compared with those who used non-sedating antihistamines. Second, the sedating-antihistamines group also contained employees who were also using non-sedating antihistamines. It could have been that these employees used the non-sedating medication on particularly troublesome days or that

**TABLE 4**  
Percent Meeting Weekly Productivity Standard

|                 | No Allergy<br>( <i>n</i> = 307) | With Allergy<br>( <i>n</i> = 327) | Chi-Squared<br>( <i>P</i> ) |
|-----------------|---------------------------------|-----------------------------------|-----------------------------|
| Time period (%) |                                 |                                   |                             |
| Pre-season      | 68.73                           | 67.78                             | 0.4784                      |
| Ragweed season  | 70.87                           | 67.41                             | 0.009*                      |
| Post-season     | 71.74                           | 73.91                             | 0.1087                      |

\* *P* < 0.01.

**TABLE 5**  
Self-Reported Symptom Severity and Choice of Medication

|                                              | Allergy Symptom Severity |                     | Chi-Squared<br>( <i>P</i> ) |
|----------------------------------------------|--------------------------|---------------------|-----------------------------|
|                                              | Mild                     | Moderate/<br>Severe |                             |
| Medication group (%)                         |                          |                     |                             |
| No medication ( <i>n</i> = 71)               | 71.8                     | 28.1                |                             |
| Sedating Antihistamines ( <i>n</i> = 175)    | 58.9                     | 41.1                | 0.057                       |
| Non-sedating antihistamines ( <i>n</i> = 81) | 53.1                     | 46.9                | 0.018*                      |

\* *P* < 0.05.

**TABLE 6**  
Comparison by Group During the Ragweed Season

| Groups                                       | % Meeting Weekly<br>Productivity Standard | <i>P</i><br>(Compared With<br>No-Allergy Group) |
|----------------------------------------------|-------------------------------------------|-------------------------------------------------|
| No allergy ( <i>n</i> = 307)                 | 70.88                                     |                                                 |
| With allergy ( <i>n</i> = 327)               | 67.41                                     | 0.0090*                                         |
| No medication ( <i>n</i> = 71)               | 63.75                                     | 0.0011*                                         |
| Sedating antihistamines ( <i>n</i> = 175)    | 68.46                                     | 0.2387                                          |
| Non-sedating antihistamines ( <i>n</i> = 81) | 68.42                                     | 0.1185                                          |

\* *P* < 0.01.

**TABLE 7**  
Odds of Attaining the Productivity Standard\*

| Groups                                       | OR    | 95% CI |       | Chi-Squared<br>( <i>P</i> ) |
|----------------------------------------------|-------|--------|-------|-----------------------------|
|                                              |       | Lower  | Upper |                             |
| With allergy ( <i>n</i> = 327)               | 0.744 | 0.643  | 0.862 | 0.0001 <sup>†</sup>         |
| No medication ( <i>n</i> = 71)               | 0.672 | 0.504  | 0.78  | 0.0001 <sup>†</sup>         |
| Sedating antihistamines ( <i>n</i> = 175)    | 0.758 | 0.609  | 0.943 | 0.0131 <sup>‡</sup>         |
| Non-sedating antihistamines ( <i>n</i> = 81) | 0.793 | 0.671  | 0.938 | 0.0067 <sup>§</sup>         |

\* OR, odds ratio; CI, confidence interval.

<sup>†</sup> *P* < 0.001.

<sup>‡</sup> *P* < 0.05.

<sup>§</sup> *P* < 0.01.

they alternated or combined the two types of antihistamines. Any of these possibilities may have attenuated the overall lack of additional impact of the sedating antihistamines on productivity.

The third factor concerns the job observed in this study. Telephone customer service, although requiring concentration and (interpersonal) attention, has little else in common with more overt behavioral, motor-

skill-dependent tasks such as driving a car or operating machinery. Reaction time has nowhere near the importance in customer service work as it does in tasks of the latter type. It may be that the customer service job skills that suffered the greatest negative impact from the sedating antihistamines were not measured in this study. The sedating antihistamines may have produced substantial deficits in such variables as the success of the interaction between the customer and the representative, the amount of product sold, or the amount of money collected—all important but unmeasured productivity variables of the job.

Although there was no evidence of the differential impact of sedating versus non-sedating antihistamines on job productivity, this study may still have implications for pharmacy benefit plans. Given the increased cost of the newer, non-sedating antihistamines over the older, sedating drugs, some pharmacy benefit managers may be reluctant to include the former in their plan's covered formulary. The approximate cost of a week's supply of the leading non-sedating antihistamine is \$18. It was observed that employees with allergies who did not use medication showed a 10% reduction in their productivity during allergy season relative to employees who did not suffer from allergies. This resulted in a loss of \$52 per employee per week. Employees with allergies who used medication suffered only a 3% drop in their productivity, or a loss of \$15.63 per week. The difference in costs associated with productivity loss between the two groups amounts to \$36.37. Even at 100% coverage by a pharmacy benefit plan, an investment of \$18 per week for the non-sedating antihistamine could produce a return of \$18.37 in increased productivity, or an immediate return on investment of just over 2 to 1. Along with the literature reviewed earlier, which makes a strong case for the use of non-sedating antihistamines for both safety and productivity rea-

sons, this analysis would seem to make the provision of benefit coverage for these medications defensible from a cost-benefit perspective.

Finally, given the measurable and significant decrease in productivity associated with allergies during periods of high pollen levels, company-sponsored wellness programs dealing with allergies also seem to be a worthwhile intervention. These programs, which are usually aimed at teaching participants to reduce allergy triggers, may strategically serve those employees who are cautious about taking any medication and prefer a more "natural" approach to their ailment. The programs may also include information about the use of medication for those who are considering it. Both messages may serve to decrease the company's productivity loss attributable to allergies and enable the typical program to more than pay for itself.

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