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*The Peer-Reviewed Journal Read by Decision Makers in Managed Care*

Health Economics

# THE DIRECT AND INDIRECT COST BURDEN OF ATOPIC DERMATITIS: AN EMPLOYER-PAYER PERSPECTIVE

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**The goal of this study was to quantify the incremental direct medical and indirect work-loss costs associated with patients diagnosed with atopic dermatitis (AD). A de-identified administrative claims database was used comprising 5.1 million covered beneficiaries from 31 Fortune 500 self-insured employers between 1998 and 2005. Patients with at least two AD diagnosis claims (N = 13,749) were compared with three matched controls (based on yr of birth and gender) with no AD diagnosis (N = 41,247). In addition, a multivariate two-part regression analysis was used to isolate the cost increase attributable to AD by controlling for confounding factors such as age, gender, health plan type, comorbidities, organ transplantation, industry of employer, region, and year. Direct medical and indirect work-loss costs for the AD group were higher on average by $88 and $64 per patient per month, respectively (both *P* < .001). After multivariate adjustment, the total incremental cost per patient per month for the AD group was $83 (direct: $52, *P* < .001; indirect: $31, *P* < .001). Employer-payers experience a significant annual cost burden of $991 per patient attributable to AD. Employee disability and increased sick days account for 38% of the cost burden.**

Atopic dermatitis (AD) is a chronic inflammatory skin disorder of unknown cause that may relate to genetic immune dysfunction and environmental antigens.[1] The condition is highly correlated with other allergic conditions, such as asthma and hay fever, and is characterized by symptoms of incessant pruritus, presence of recurrent eczematous lesions, xerosis, and frequent secondary skin infections. Although AD has no known cure, it is highly treatable with topical therapies, including such topical steroids and nonsteroidal treatments as pimecrolimus and tacrolimus.[2–4] Atopic dermatitis is common in children, with a prevalence rate of about 20% in the United States.[5,6] In the vast majority of cases, AD occurs before age 5.[7] Although the typical lesions of AD in childhood usually disappear by adulthood, adults with AD carry a lifelong significantly increased risk of hand eczema, especially if their work involves frequent hand washing.[5] The lifetime prevalence of AD in the U.S. population is about 10%.[8]

The effect of AD on patients, the health care system, and society are multidimensional. Kiebert and associates[9] reported that AD had a detrimental effect on patients' health-related quality of life, especially in terms of

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social functioning and psychological well-being. The condition has a significant effect on health care resources, accounting for 10% to 20% of dermatologist visits.[10] Ellis and associates[11] found that 2.4% of a privately insured population and 2.5% of a state Medicaid population in 1997 to 1998 sought medical care for AD and eczema.

The cost of AD to managed care payers in the United States was previously estimated by Ellis and associates[11] and Fivenson and associates.[12] Using claims data for 35,404 patients with AD or eczema during 1997-1998, Ellis and researchers[11] estimated the direct medical care and prescription drug costs associated with AD and eczema to range from $141 to $580 per patient per year (in 1997 dollars), depending on the extent to which the costs of comorbidities were included.

Fivenson and colleagues[12] studied both the direct and indirect costs associated with treating AD. The research combined information from administrative claims data, patient surveys, and medical charts for 298 patients with AD in a managed care plan in Detroit in 1997. The study found the average annual cost per patient associated with AD to be $609 (in 1997 dollars). Approximately 27% ($167) of the cost represented direct treatment and prescription costs born by third-party payers, 23% ($147) represented out-of-pocket costs to patients and their families, and the remaining 50% of the cost ($295) was associated with days lost from work.

A significant finding of the Fivenson[12] study was that AD-related costs varied considerably with the severity of illness. Their estimates of the average annual cost associated with AD varied from $435 for patients with mild conditions to $3,229 for patients with severe conditions; a ratio of approximately 7:1. Barbeau and Lalonde[13] recently examined the relationship between AD severity and costs in Canada, and found that patients with severe conditions resulted in total direct and indirect costs (including patient out-of-pocket costs) that were more than four times greater than those patients with mild conditions.

In this study, a large sample of administrative claims paid by 31 self-insured U.S. employers over the period 1998-2005 was used to obtain a more up-to-date estimate of the incremental direct and indirect cost burden associated with AD. Relative to the study by Fivenson and associates,[12] this sample covers a more recent period and is much larger and more nationally representative. Relative to Ellis and colleagues'[11] research, the present data are not only more recent, but they allow the measurement of both direct costs (medical and prescription drug costs) and indirect costs (disability payments and value of missed work time) of AD. Moreover, rather than attempt to identify the claims directly related to the treatment of AD, as the previous studies have done, a matched control group and multivariate analysis was used to determine the incremental cost burden from an employer-payer perspective. In the multivariate analysis, the presence of common comorbidities was controlled for to better isolate the costs associated with AD.

## METHODS AND SUBJECTS

**Data Source.** De-identified health and disability administrative claims data were used to assess the incremental cost burden associated with AD. The administrative claims data covered the period January 1, 1998 through January 31, 2005 and included approximately 5.1 million employees, along with their spouses and dependents, from 31 large, self-insured Fortune 500 U.S. companies. Collectively, these 31 companies have operations throughout the United States and represent a broad array of industries, including financial services, transportation, high technology, manufacturing, telecommunications, energy, and food and beverage. The database includes patient demographics and health plan enrollment information, inpatient and outpatient diagnoses and procedures, and outpatient prescription drug claims for all beneficiaries. Short- and long-term disability claims are available for active employees.

Several types of health care plans are reflected in the data. Health maintenance organizations require members to choose a PCP from the HMO network to provide health care coordination and to provide referrals to specialists who must be within the HMO network. Preferred provider organizations allow patients to choose a physician from the provider network or to receive service from a physician in a nonparticipant network at a reduced benefit level. Under this type of plan, a referral to see a specialist is not required. Point-of-service plans combine aspects of the HMO and PPO plans. In these plans, a PCP coordinates treatment and makes referrals, but patients also have the option of being referred to a specialist or health care facility outside of the provider network at a reduced benefit level. The data also include indemnity plans that reimburse for medical expenses regardless of the provider. A residual "other" plan category was created to capture patients with an unspecified health plan or a health plan that does not fall into the above categories.

The cost categories analyzed in this study consisted of direct health care costs paid by the employer (inpatient and outpatient services, outpatient pharmacy prescriptions) and indirect work-loss costs. The indirect costs of lost work time were calculated as the sum of employer disability payments and sick-leave time multiplied by the employee's wage. If the employee's wage was not reported, it was predicted from a regression of socioeconomic characteristics on annual wages.

To ensure a complete medical claims history, the study included only patients with no interruption in health plan coverage. Similarly, patients 65 years of age or older were excluded because of possible dual coverage by Medicare (Table I).

All monthly costs were adjusted for inflation using the medical care consumer price index (CPI) from the U.S. Bureau of Labor Statistics. Costs are expressed in constant 2005 dollars.

**Study Design.** A retrospective matched cohort design was employed. The AD group comprised patients with at least two AD claims (*International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM] code 691 or 691.8). The study period for patients with AD began on the service date of the first AD claim and continued until the earliest of the health plan termination date or the

defined study end date (January 31, 2005). The control group was identified by matching each individual in the AD cohort with three individuals of the same gender and year of birth who had at least two claims but did not have any AD claims. The observation start date in the control group was defined as the health plan enrollment start date plus an imputed pre-AD period equal to the average number of months between the health plan enrollment start date and the date of the first AD claim for patients in the AD group (2 mo). This adjusted observation start date accounted for the gap between health plan enrollment and the diagnosis of AD in the AD group, and the adjustment ensured that the control group would not be observed on average for a longer period than the AD group.

**TABLE I: SAMPLE SELECTION METHODOLOGY FOR THE AD GROUP**

| Inclusion Criteria | Remaining | Removed |
|---|---|---|
| AD Group for Direct Medical Cost Analysis | | |
| Patients with 1 AD diagnosis | 81,608 | |
| Patients with 2 AD diagnoses | 20,277 | 61,331 |
| Patients with continuous health plan enrollment | 17,702 | 2,575 |
| Patients with total health care costs ≥ 0 | 17,547 | 155 |
| Patients < 65 yr | 14,308 | 3,239 |
| Requirement of 1:3 ratio between AD patients and controls | 13,749 | 559 |
| AD Group for Indirect Work-Loss Analysis | | |
| Members of the AD group who are active employees | 3,042 | 10,707 |
| Active employees with short- and long-term disability data | 1,616 | 1,426 |

AD = Atopic dermatitis.

**TABLE II: MEAN BASELINE CHARACTERISTICS FOR THE AD GROUP AND THE MATCHED CONTROL GROUP**

| Characteristic | AD Group (N = 13,749) | Control Group (N = 41,247) | *P* Value* |
|---|---|---|---|
| Demographics | | | |
| Age (yr, mean ± SD) | 21.2 ± 20.9 | 20.8 ± 20.7 | .045† |
| Distribution by age (yr) | | | |
| 0–8 | 44.1% | 44.9% | .096 |
| 9–16 | 12.7% | 12.1% | .094 |
| 17–24 | 4.4% | 4.6% | .455 |
| 25–32 | 5.8% | 5.9% | .503 |
| 33–40 | 8.2% | 8.5% | .296 |
| 41–48 | 8.8% | 8.5% | .268 |
| 49–56 | 9.0% | 9.2% | .544 |
| 57–64 | 7.1% | 6.3% | .003† |
| Female (%) | 53.0% | 53.0% | 1.000 |
| Active employee (%) | 20.3% | 18.1% | < .001† |
| Annual wages | $49,696 | $48,691 | .389 |
| Observation duration (mo) | 27.6 | 27.8 | .127 |
| Comorbidities (ICD-9-CM code) (%) | | | |
| Acute URI (465) | 35.6% | 26.3% | < .001† |
| Acute pharyngitis (462) | 24.0% | 18.2% | < .001† |
| Allergic rhinitis (477) | 31.5% | 12.3% | < .001† |
| Asthma (493) | 17.1% | 6.7% | < .001† |
| Otitis media (382) | 24.5% | 19.3% | < .001† |
| Health Plan Type (%) | | | |
| HMO | 9.6% | 8.1% | < .001† |
| POS | 46.5% | 43.2% | < .001† |
| PPO | 33.4% | 34.8% | .004† |
| Indemnity | 9.9% | 13.3% | < .001† |
| Other | 0.6% | 0.7% | .021† |

**P* value for testing the null hypothesis that mean AD = mean control; Pr > | t |.
†Statistically different at 5% level (two-tailed *t*-test).
AD = Atopic dermatitis; N = number; SD = standard deviation; ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification*; URI = upper respiratory infection.

**Statistical Analysis.** The inflation-adjusted direct and indirect costs were averaged over the observation period and reported as per-patient per-month (PPPM) costs. Incremental PPPM costs associated with AD were computed by taking the difference between the average monthly costs of the AD group and the matched control group. By comparing patients with AD to a control group matched by year of birth and gender rather than to the overall population covered by the employer's benefit plan, cost estimates independent of age and gender effects were obtained. Student's paired *t*-test was used to assess the statistical significance of the cost difference between the AD and control groups.

In addition, a multivariate two-part regression model was used to isolate the incremental costs associated with AD by adjusting for factors that were potentially unevenly distributed between the AD and control groups. Covariate factors included in the model were the patient's age group, gender, common comorbidities associated with AD (acute upper respiratory infections, acute pharyngitis, allergic rhinitis, asthma, and otitis media),[14] treatment for expensive procedures (organ transplantation), health plan type, hospital treatment, claimant type (subscriber, dependent), industry of the employer, calendar year, and region of residence. A two-part estimation procedure was used because health care expenditures are truncated at zero and tend to be skewed towards the upper end of the distribution, so they do not follow a normal distribution.[15]

The two-part model first estimated

**TABLE III: UNIVARIATE DIRECT AND INDIRECT COSTS ASSOCIATED WITH AD (CONSTANT 2005 DOLLARS PPPM)**

| | AD Group (N = 13,749) | | | Control Group (N = 41,247) | | | Incremental Costs | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 95% CI | | | 95% CI | | | 95% CI | | |
| Costs | Mean | Lower | Upper | Mean | Lower | Upper | Diff | Lower | Upper | *P* Value* |
| Medical Costs | | | | | | | | | | |
| Medical Services | $270 | $253 | $287 | $223 | $197 | $249 | $47 | $1 | $92 | .003† |
| Prescription Drugs | $80 | $77 | $83 | $38 | $37 | $39 | $42 | $39 | $44 | < .001† |
| Total Direct Costs | $349 | $331 | $367 | $261 | $235 | $287 | $88 | $43 | $134 | < .001† |
| | **AD Group (N = 1,616)*** | | | **Control Group (N = 3,950)*** | | | **Incremental Costs*** | | | |
| | | 95% CI | | | 95% CI | | | 95% CI | | |
| Costs | Mean | Lower | Upper | Mean | Lower | Upper | Diff | Lower | Upper | *P* Value* |
| Work-Loss Costs | | | | | | | | | | |
| Disability | $112 | $94 | $130 | $54 | $51 | $57 | $57 | $45 | $70 | < .001† |
| Sick Leave | $37 | $25 | $49 | $30 | $24 | $36 | $6 | –$6 | $18 | .322 |
| Total Indirect Costs | $148 | $126 | $170 | $85 | $78 | $92 | $64 | $46 | $81 | < .001† |
| Total Costs | $497 | $457 | $537 | $346 | $313 | $379 | $152 | $89 | $215 | < .001† |

**P* value for testing the null hypothesis that mean AD cost = mean control cost; Pr > | t |.
†Mean AD cost statistically > mean control cost at 5% level (two-tailed *t*-test).
AD = Atopic dermatitis; PPPM = per patient per month; N = number; CI = confidence interval; Diff = mean AD cost – mean control cost.

the probability of the patient's monthly cost being positive, and then estimated the expected monthly cost conditional upon the cost being positive. The unconditional cost was obtained by multiplying the predicted probability of a positive cost by the corresponding expected cost conditional on observing a positive cost. The estimated incremental cost of AD was calculated as the difference between the unconditional costs of the patients with AD and the patients without AD. Standard errors of the estimates were estimated using a bootstrap procedure with 1,000 replications.[16]

The two-part regression model assumed that the costs followed a gamma distribution and that the variance was proportional to the square of the mean (gamma with log-link).[15] The validity of this specification was tested using the modified Park test as suggested by Manning and Mullahy.[17] The two-part model imposes fewer assumptions than either ordinary least squares or Tobit, and the estimates are insensitive to the presence of extreme values. The two-part model was estimated using the Probit and GLM procedures in STATA version 9.2.

## RESULTS

**Patient Characteristics.** For the analysis of direct medical costs, a total of 13,749 patients with AD were matched with 41,247 controls. With the exception of the AD claims requirement, the matched control group was created using the same methodology. For the analysis of indirect work-loss costs, only active employees with work loss data were analyzed, which resulted in 1,616 patients with AD and 3,950 controls.

The AD and control groups had the same percentage of female patients by design, and were similar with respect to the average age, annual wage earnings, and observation duration (Table II). Approximately 57% of the patients with AD were 16 years of age or younger, with an average age of 21.2 years. The average age at baseline was not identical in the AD and control groups because patients were matched based on year of birth but could be observed in the data starting at different points in time. The AD group had a higher comorbidity prevalence than the control group for acute upper respiratory infections, acute pharyngitis, allergic rhinitis, asthma, and otitis media. Slightly more patients with AD were active employees and subscribed to HMO and POS health plan types.

**Univariate Results.** The mean total direct costs were statistically significantly higher for patients in the AD group than those of the control group (mean PPPM cost: $349 vs. $261; $P < .001$) (Table III). The mean incremental cost of $88 PPPM (95% confidence interval [CI]: $43–$134) associated with the AD group was attributable to an increase in both medical services ($47) and prescription drugs ($42).

Likewise, the indirect work-loss costs for the subset of active employees in the AD group were also significantly higher than the control group (mean PPPM cost: $148 vs. $85; $P < .001$). The mean incremental cost of $64 PPPM (95% CI: $46–$81) associated with the AD group was primarily a result of increased short- or long-term disability costs ($57).

Overall, the AD group was associated with a total incremental cost of $152 PPPM (95% CI: $89–$215; $P < .001$), with 58% of the cost differential a result of medical and pharmacy costs (31% medical services, 27%

**TABLE IV: MULTIVARIATE ANALYSIS OF THE DIRECT AND INDIRECT COSTS ASSOCIATED WITH AD**

| | Direct Costs | | | | | |
|---|---|---|---|---|---|---|
| | Change in Prob. of Cost > 0 | | | % Change in Cost \| Cost > 0 | | |
| Control Variables* | Estimate | SE | *P* Value | Estimate | SE | *P* Value |
| Atopic Dermatitis | 0.177 | 0.003 | < .001† | 0.068 | 0.014 | < .001† |
| Comorbidities (ICD-9-CM code) | | | | | | |
| Asthma (493) | 0.129 | 0.004 | < .001† | 0.221 | 0.017 | < .001† |
| Allergic rhinitis (477) | 0.128 | 0.003 | < .001† | 0.053 | 0.016 | .001† |
| Acute URI (465) | 0.108 | 0.003 | < .001† | 0.060 | 0.015 | < .001† |
| Acute pharyngitis (462) | 0.064 | 0.003 | < .001† | 0.016 | 0.015 | .298 |
| Otitis media (382) | 0.100 | 0.003 | < .001† | 0.100 | 0.016 | < .001† |
| Observations | N = 1,776,016 | | | N = 817,028 | | |

| | Indirect Costs | | | | | |
|---|---|---|---|---|---|---|
| | Change in Prob. of Cost > 0 | | | % Change in Cost \| Cost > 0 | | |
| Control Variables* | Estimate | SE | *P* Value | Estimate | SE | *P* Value |
| Atopic Dermatitis | 0.166 | 0.008 | < .001† | 0.100 | 0.019 | < .001† |
| Comorbidities (ICD-9-CM code) | | | | | | |
| Asthma (493) | 0.088 | 0.014 | < .001† | 0.089 | 0.028 | .002† |
| Allergic rhinitis (477) | 0.134 | 0.009 | < .001† | 0.040 | 0.020 | .045† |
| Acute URI (465) | 0.084 | 0.008 | < .001† | –0.003 | 0.020 | .862 |
| Acute pharyngitis (462) | 0.070 | 0.010 | < .001† | –0.050 | 0.022 | .026† |
| Otitis media (382) | 0.060 | 0.015 | < .001† | –0.069 | 0.032 | .031† |
| Observations | N = 197,660 | | | N = 72,018 | | |

| | Incremental Costs | | | | | |
|---|---|---|---|---|---|---|
| | Direct Costs | | | Indirect Costs | | |
| Variable | Estimate | SE | *P* Value | Estimate | SE | *P* Value |
| Atopic Dermatitis | $51.51 | $1.29 | < .001† | $31.06 | $0.05 | < .001† |

*Additional control variables were age, gender, employment status (for direct cost estimate), industry of employer, region, health plan type, hospital treatment, and year.
†Statistically different from zero at 5% level (two-tailed *t*-test).
AD = Atopic dermatitis; Prob. = probability; N = number; ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification*; URI = upper respiratory infection.

prescription drugs), and the remaining 42% from indirect work-loss costs (38% disability, 4% sick leave).

**Multivariate Results.** The multivariate two-part regressions use essentially the same sample selection criteria previously summarized in Table I, but the cost values for each patient are not aggregated over time, and so the multivariate results are based on a very large number of patient-month observations. The first part of the regression analysis, which estimates the probability of observing a positive cost value, is based on 1,776,016 (direct) and 197,660 (indirect) patient-month observations. The second part of the regression analysis, which estimates the expected monthly cost conditional on observing a positive cost, is based on 817,028 (direct) and 72,108 (indirect) patient-month observations.

The results from the multivariate two-part regression confirmed that patients with AD incurred significantly higher direct and indirect costs than the non-AD controls. Table IV shows the estimation results for the two-part regression model. Atopic dermatitis increased the probability of observing a positive direct health care cost by 17.7 percentage points. In the case of indirect work-loss costs, AD increased the probability of observing a positive cost value by 16.6 percentage points. For those patients with positive health care costs, the AD group incurred 6.8% higher direct costs and 10% higher indirect costs than comparable patients without AD. These differences in health care utilization and costs translated into an expected monthly direct cost burden of $51.51 PPPM ($P <$ .001), and a monthly indirect cost burden of $31.06 PPPM ($P <$ .001). Overall, the total adjusted cost burden associated with AD was $82.57 PPPM ($P <$ .001), or $991 per patient per year, with about 38% of the total adjusted burden resulting from indirect costs.

The direct and indirect cost burden estimates from the multivariate model were lower than the univariate estimates by $36 and $33 PPPM, respectively (Figure). The distribution of the AD cost burden between direct costs (62%) and indirect costs (38%), however, was similar to that found in the univariate analysis (58% direct, 42% indirect). The difference in the cost burden estimates was primarily caused by the costs associated with comorbidities. When the comorbidities were dropped from the multivariate regression, the total incremental cost of AD was estimated to be $162 PPPM, which was very close to the univariate estimate of $152 PPPM.

## DISCUSSION

This study provides evidence that AD represents a more substantial cost burden to employer-payers than previous studies of third-party payers have indicated.[11,12] Focusing specifically on a large sample of claims from 31 Fortune 500 employer-payers for the period 1998–2005, the direct and indirect costs of AD were estimated to be $1,824 per patient per year using a univariate matched control analysis, and $991 per patient per year using multivariate analysis that also controlled for the presence of common comorbidities. The cost burden of AD took the

form of both increased medical costs and lost work time, with the latter accounting for approximately 40% of the incremental cost in both the univariate and multivariate analyses.

The lower multivariate estimate of the incremental direct and indirect costs of AD exceeds the costs associated with treating serious gastrointestinal conditions such as gastroesophageal reflux disease (GERD), gallbladder disease, peptic ulcer disease, and irritable bowel syndrome. Sandler and associates[18] estimated the total direct and indirect costs associated with treating GERD to be approximately $671 per patient per year (in 2005 dollars).

Although controlling for the presence of comorbidities through multivariate regression allows researchers to more precisely isolate the costs attributable specifically to AD, the broader measure of costs resulting from the univariate analysis is nonetheless valuable. Evidence exists that AD increases the risk of developing comorbidities such as allergic rhinitis and asthma (the atopic triad), and that asthma is more severe and more persistent among patients with AD.[19] Consequently, to the extent AD is a causal factor in the other conditions, it is appropriate to include those costs in the burden of AD. When allergic rhinitis and asthma were dropped from the multivariate analysis, the incremental cost of AD increased to $151.83 PPPM, or $1,822 per patient per year. This was essentially the same result found in the univariate analysis. Thus, the multivariate results shown in Table IV can be interpreted as a conservative estimate of the cost burden of AD.

Moreover, the incremental cost burden of AD estimated in this study is likely to underestimate the true cost burden of AD for at least two additional reasons. First, disability and sick-leave payments represent only a portion of the total costs incurred by employers because of employee absenteeism. Employers must either hire and train replacement employees or bear the burden of reduced productivity and workflow disruption. A study by Wyatt[20] suggested that for each dollar spent on disability leave, an additional workforce disruption cost of $1.50 is incurred. The presence of these additional workforce disruption costs would mean that these disability cost estimates represent only about 40% of the true indirect cost burden to the employer. Second, this estimate of the incremental cost burden of AD did not include losses in worker productivity stemming from the adverse effects on the quality of life experienced by patients with AD. Previous studies have demonstrated that patients with AD are prone to social and emotional problems and sleep disturbances.[9,21] Consequently, even if employees do not use sick leave or disability time, employers are likely to face certain presenteeism costs in the form of workers who are not fully productive.

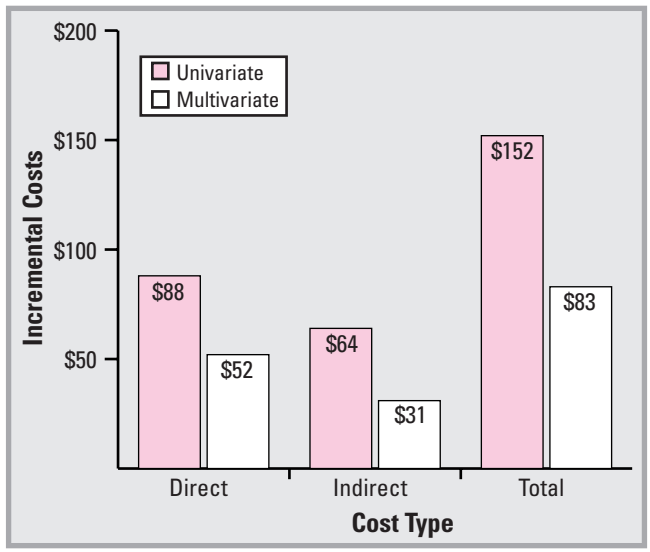


**Figure.** Estimates of the incremental cost burden associated with atopic dermatitis in constant 2005 dollars PPPM.* All incremental costs are statistically significant > 0 ($P < .001$).

The data used in this study represent a significant update relative to earlier studies of third-party payers by Ellis[11] and Fivenson,[12] both of which used data from 1998 or earlier. Moreover, although the Ellis[11] study was based on a large sample, it did not have the ability to measure work-loss costs. On the other hand, Fivenson[12] used multiple methodologies to measure direct costs paid by third-parties, indirect work-loss costs, and patient out-of-pocket costs. However, the sample was small and not nationally representative. Fivenson[12] found indirect costs to account for about one-half of the total costs; therefore, it was particularly important to update both the direct and indirect cost estimates using a larger national sample.

The annual direct costs per patient attributable to AD ($618) in this study was substantially higher than in the Ellis[11] ($195) and Fivenson[12] ($230) studies (published estimates converted to 2005 dollars). The estimate in this study of the annual incremental indirect costs per patient was $170 higher ($373 vs. $203) than that estimated by Fivenson.[12]

Overall, the current estimate of the total incremental costs of AD was similar to that obtained by adding together the upper bound estimate by Ellis[11] that included the cost of comorbidities ($799 in 2005 dollars) with the indirect costs estimated by Fivenson[12] ($203). This was the approach to estimating the total cost burden of AD suggested by Ellis and associates[22] in a comment on the Fivenson[12] study. Since this analysis controlled for comorbidities, however, these results indicate a much higher total cost burden from AD alone when compared with previous studies.

**Limitations.** The main limitation of this study relative to previous work is that the administrative claims database did not include an assessment of the severity of AD. Consequently, it cannot be determined with certainty whether these estimates of the incremental costs of AD are inflated by having a disproportionate number of patients with particularly severe cases of AD. The researchers did, however, examine several proxies for disease severity, and these proxies suggested a severity distribution similar to that in the Fivenson[12] study. For example, only a very small percentage of claims (0.3%) involved inpatient hospital or emergency room treatment, and this percentage matched that in the Fivenson[12] study. In addition, the

percentage of claims involving treatment by a dermatologist was lower than in the Fivenson[12] study (47.5% vs. 66.1%), whereas the percentage of claims involving treatment by a pediatrician or general practitioner was higher than that reported by Fivenson.[12] It is expected that more severe cases of AD will be treated by a dermatologist, and so this result again suggests that this sample does not have a disproportionate share of severe cases. Finally, the extent to which patients in this sample made AD claims was examined over several years. The researchers found that 49.3% of patients made all of their claims in the same year, whereas less than 1% of patients made claims in five or more years. To the extent that claims being confined to a single year is an indicator of a mild condition, this distribution is very similar to that in the Fivenson[12] study (51% of adult patients with mild condition, 2.8% with severe condition, based on provider-assessed severity).

An additional limitation of the employer-payer perspective is that it ignores patient out-of-pocket costs, which Fivenson[12] estimated at $406 per patient per year (converted to 2005 dollars) or about 27% of total costs. A complete assessment of the cost burden to society would include not only attention to patient out-of-pocket costs, but also the significant quality-of-life issues faced by patients with AD and their families.

Nonetheless, the data in this study indicate that AD costs per patient per year in real terms represent a substantial cost burden. It is unclear, however, precisely why the current cost estimates are higher than previous studies. Certainly, treatment patterns for AD continue to evolve. Whereas no consistent treatment guidelines exist for AD based on disease severity, efforts have been made to develop guidelines similar to those developed for the treatment of asthma.[23] The extent to which this effort to develop consensus guidelines has affected treatment practices, and ultimately the cost of treatment, is unclear. Additional studies using recent direct and indirect cost data from a large nationally representative sample of patients would be helpful in further assessing the total cost burden of AD.

## CONCLUSION

Using a large national sample of administrative claims data from 31 large self-insured U.S. employers over the period 1998 to 2005, the total direct and indirect costs of AD to employer-payers were found to be $991 per patient per year. This estimate is more than twice as large as that found by Fivenson[12] using a much smaller 1997 sample of claims from a managed care plan in Detroit. This cost estimate is substantially larger despite the fact that the presence of common comorbidities were controlled for in a two-part multivariate regression framework. To the extent that AD actually increases the risk of developing the other parts of the atopic triad (allergic rhinitis and asthma), this multivariate regression methodology represents a conservative approach to measuring the total incremental cost of AD.

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### DISCLOSURE


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