Predictors of Healthcare Outcomes and Costs Related to Medication Use in Patients With Acne in the United States

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This study investigated the relationship among health status, costs linked with the treatment of acne in the United States, and other aspects related to medication use. The US Medical Expenditure Panel Survey (MEPS) database was analyzed for a cohort of people with acne. This cross-sectional study obtained costs, demographics, healthcare service utilization, and clinical patient variables from the MEPS database. The EuroQol Group's EQ-5D scores available in MEPS were used for health status information. Multivariate weighted analysis was performed for data for approximately 5 million patients (weighted sample size). Nearly 70% of the patients used some type of medication for acne. Acne-related medication accounted for approximately 36% of the total acne-related annual healthcare costs, with an average of 2 annual acne prescription refills per patient. Increased number of refills of acne-related medications was associated with an improvement in health status (P<.05). Increased physician office-based visits were the only predictors of higher acne-related annual healthcare costs (P<.01). Adherence to acne medications is an important component of better health status. Pharmacologic treatment of acne does not significantly add to acne-related annual healthcare costs.

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Acne vulgaris is the most common skin disease treated in the United States, affecting up to 85% of people aged 12 to 25 years[1] and approximately 95% of the population at some time during their lives.[2] Acne accounts for a tremendous number of visits to both generalists and dermatologists. It also is the most common disorder for which people aged 15 to 40 years visit a dermatologist.[3] One study indicated that an estimated 5 to 6 million visits are made to dermatologists every year,[4] resulting in billions of dollars spent on the treatment of acne.[3] Medications also are thought to be important contributors to this expense, with a number of cost-effectiveness/pharmacoeconomic studies on acne medications conducted over the years.[5-8] The finite nature of healthcare resources has increased the importance of cost-based studies of treatment for diseases such as acne.

Acne is associated with psychiatric and psychologic processes, more so than other dermatologic conditions; additionally, acne has important non-dermatologic significance.[9] Acne vulgaris markedly can affect patient quality of life (QOL).[9] The decrease in QOL caused by acne is comparable with other severe chronic illnesses.[10] Although there have been several studies conducted looking at QOL and costs associated with acne,[5-10] none have been performed, to our knowledge, using large national

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databases such as the Medical Expenditure Panel Survey (MEPS). This study hopes to curtail this gap by investigating the relationship between health status and costs linked to the treatment of acne in the United States, as well as other aspects related to medication use, using the MEPS database.

Methods

Sample and Measurement—This was a cross-sectional cohort study. The 2000 MEPS dataset was analyzed for this study. MEPS is a national survey of noninstitutionalized US civilians. The MEPS dataset quantifies insurance costs and out-of-pocket spending for all medical services. Each MEPS panel is a sample population from the previous year's National Health Interview Survey respondents. MEPS collects self-reported health status data using the EuroQol Group's EQ-5D instrument for all respondents 18 years and older. Hence, analysis for health status was conducted for this age group. MEPS also includes data on the sociodemographic characteristics of respondents and self-reported medical conditions, defined on the basis of the first 3 digits of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. The patients for this study were identified using the ICD-9-CM (code 706.xx) for acne vulgaris and similar conditions. Records of medical events for each patient were obtained using this ICD-9-CM code for acne vulgaris. Records of the receipt of acne medication as identified by a dermatologist also were obtained. This included information on office-based visits to a medical provider and outpatient visits. Each medical event was collapsed to one record for each acne patient containing the number of visits, total amount paid for office-based visits, number of visits for acne, and total amount paid for acne visits. This information was used in obtaining acne-related annual healthcare costs. For prescribed medicines, a dermatologist identified medications for acne. Data regarding the different types and forms of prescribed acne medications used by the patients were obtained from the MEPS dataset. For the purpose of analysis, the study population was divided into categories based on the type of medication used (eg, oral antibiotics, oral retinoids, topical antibiotics, topical retinoids, topical combinations). Information regarding self-reported health status of the patients and other patient variables was retrieved from the MEPS dataset.

Next, a comorbidity index was developed based on the approach of Charlson and colleagues.[11] This index has been validated for several other health outcome estimations besides death and has been adapted for use with ICD-9-CM codes.[12] The index assigns weights for a number of major conditions (ranging from 0–6). The index severity score is calculated for each patient by totaling the assigned weight for each of the patient's comorbidities, with higher scores indicating greater severity of comorbidity. Patients without any comorbidity received a score of 0. An additional index was created to measure the total number of prescription refills.[13]

Statistical Analysis—Data for approximately 5.68 million acne patients (weighted sample size) in the 2000 MEPS dataset were analyzed. All analyses were weighted using the MEPS sampling weights. The unit of analysis for all analyses was the individual patient. Bivariate statistics were used (1-way analysis of variance) to compare all potential predictors of healthcare costs and health status. Confounders from the bivariate analyses that were correlated with either study outcomes were included in the multivariate regression models examining the impact of type of pharmacotherapy on healthcare costs and health status.[14] All analyses were conducted using Stata® software.

Results

The majority of the population was aged 25 years and younger (49.1%). Nearly 70% of the patients used some type of medication for acne; 35% of patients were being treated with oral antibiotics and 14% with topical retinoids. Acne-related medication accounted for approximately 36% of the total acne-related annual healthcare costs, with an average of 2 annual acne prescription refills per patient. Demographic information on the study population is outlined in Table 1. The average comorbidity burden in the population was minor, as evidenced by the low comorbidity score (mean=0.61). The acne-related annual healthcare costs were approximately $317.

The multivariate models examining predictors of health status (EQ-5D summary score) explained approximately 14% of the variance. The study population compliant with their acne medication, as measured by the number of refills, had significantly better health status ($P=.026$). The study population with private health insurance had significantly better health status than those with public health insurance ($P<.01$). This represented an almost 42% increase in health status scores when compared with the EQ-5D population means.

Multivariate analysis examining predictors of acne-related annual healthcare costs explained approximately 15% of the variance. The use of medications was not associated with any significant increase in acne-related annual healthcare costs. Physician office-based visits was associated with a

Table 1.

Descriptive Statistics for Study Population (N=5.68 million [weighted estimate])*†

Variable	Mean
Age, %	
0–17 y	28.1
18–25 y	21.0
26–49 y	31.3
50–64 y	12.1
≥65 y	7.5
Gender, %	
Male	40.0
Female	60.0
Race, %	
White	90.5
Other	9.5
Patients with private health insurance, %	87.5
Comorbidity, Charlson et al[11] index score (SEM)	0.61 (0.052)
Medications for acne, %	
Oral antibiotics	35.0
Oral retinoids	5.3
Topical antibiotics	5.9
Topical retinoids	14.1
Topical combinations	5.6
Other acne medications	4.7
No medications	29.4
Oral contraceptive use, %	9.0
Self-reported health status from EQ-5D, n (SEM)	46.32 (2.23)
Acne-related annual drug refills, n (SEM)	2.07 (0.17)
Acne-related annual office-based visits, n (SEM)	1.28 (0.091)
Acne-related annual office-based visits costs, $ (SEM)	119.31 (18.08)
Acne-related annual healthcare costs, $ (SEM)	316.74 (36.05)

*The EuroQol EQ-5D instrument collects self-reported health status data.
†SEM indicates standard error of the mean.

significant increase in acne-related annual healthcare costs ($P<.01$). This was a 45.8% increase in acne-related annual healthcare costs when compared with the population mean acne-related annual healthcare costs. The regression estimates of the variables included in these models is shown in Table 2.

A sensitivity analysis also was carried out for acne-related annual healthcare costs, excluding patients younger than 18 years and using patients aged 18 to 24 years as the reference category. The parameter estimates obtained from this model were almost identical to the model with patients younger than 18 years as the reference group.

Comment

This study was conducted to investigate the relationship between health status and costs linked with the treatment of acne in the United States, and other aspects related to medication use using the MEPS database. To our knowledge, this is the first study of the link between self-reported health status, medication adherence, and associated healthcare service use in a population with acne. This study has found 2 strong associations that need further mention.

First, this study indicated that increased prescription refills (a marker for increased medication adherence) was associated with an improvement in health status. Suboptimal medication adherence has been shown to be associated with treatment failure among patients with acne vulgaris,[15] which in turn would imply deterioration in health status. Compliance with acne medications is a particularly important issue because of the dermatologic and nondermatologic significance.[9] Studies have shown that a multifactorial approach is required for increasing compliance.[15] This method involves combining nonpharmacologic interventions and effective, well-tolerated, and simplified drug regimens.[15] Studies also have emphasized the importance of the physician-patient relationship, with patient counseling shown to be an important aspect of medication adherence.[16-18] The findings from our study highlight the importance of medication adherence in successful acne treatment. Measures should be devised to address the issue of medication nonadherence, as this could reflect on the health status of the patients involved.

Second, this study found that physician office-based visits were associated with an increase in acne-related annual healthcare costs. This is not surprising given the large volume of acne-related visits to dermatologists.[4] One implication of this finding is that it may be prudent and good healthcare practice for physicians to monitor patients with acne regularly to assess safety, efficacy, and

Table 2.

Multivariate Analysis for Predictors of Acne-Related Annual Healthcare Costs and Health Status*

Independent Variables	Dependent Variables, β coefficient (SE)	
	Health Status From EQ-5D (N=4.08 million [weighted estimate])†	Acne-Related Annual Healthcare Costs (N=5.68 million [weighted estimate])‡
Race		
White	8.33 (7.45)	−294.83 (224.92)
Gender		
Male	1.23 (4.73)	−16.65 (64.83)
Patients with private health insurance	19.48 (5.07)§	3.62 (124.30)
Age, y		
<18	NA	NA
18–25	NA	143.96 (91.19)
26–49	10.02 (6.15)	194.54 (135.96)
50–64	−0.80 (6.98)	174.22 (148.06)
≥65	−1.41 (9.95)	−314.60 (246.35)
Medications for acne		
Oral contraceptives	13.97 (6.92)‖	336.56 (230.11)
Other medications	−4.58 (4.21)	−106.11 (62.48)
Acne-related annual drug refills	1.28 (0.56)‖	21.18 (11.01)
Comorbidities	−2.89 (2.19)	180.03 (110.80)
No. of acne-related office-based visits	−0.12 (1.02)	145.11 (31.47)§

*NA indicates not applicable. Results related to health status are presented only for patients ≥18 y because the EuroQol EQ-5D was administered to these patients only. Patients aged 18–25 y were included in the reference group; therefore, they were not included in the regression analysis. The EQ-5D instrument collects self-reported health status data.

†R^2=0.14.

‡R^2=0.15.

§$P<.01$.

‖$P<.05$.

adherence to medication regimens before refilling prescriptions. This information also could be important to third-party payers. Medications traditionally have been thought to be the most important drivers of acne-related annual healthcare costs, with a number of cost-effectiveness/pharmacoeconomic studies on acne medications conducted.[5-8] Over the years, acne has been dismissed by the medical community and general population as a superficial affliction associated with growing up; however, scientific data have refuted this notion.[9] Our study indicated that medication use was not significantly associated with an increase in acne-related annual healthcare costs. The results of this study serve to dispel such myths and highlight the role of pharmacotherapy as a cost-effective treatment for acne.

Limitations

Although the MEPS is a nationally representative survey, respondent bias and underreporting of actual healthcare service use from self-reports and potential recall bias cannot be ruled out. There is a small potential for miscoding the clinical diagnosis of acne. Records for patients using over-the-counter medications or some other nonprescription medication–related therapy were not captured by the MEPS database. Additionally, this study could not differentiate between healthcare costs attributed to specific medications because of the small numbers of patients treated with certain medications. We had to combine broad medication categories. This study, however, did not find any cost differences among any broad medication categories. These limitations do not diminish the implications of this study's findings for dermatologic practice and treatment policy. This study has assessed costs and health status associated with acne using a nationally representative database—MEPS. The study population hence is highly representative of the US population, which strengthens the generalizability of this study.

Conclusion

The increased number of refills of acne-related medications was associated with an improvement in health status, and increased office-based visits were the only predictors of higher acne-related annual healthcare costs in patients with acne in the United States. Adherence to acne medications seems to be an important component of better health status, and pharmacologic treatment of acne does not add significantly to acne-related annual healthcare costs.

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References

1. Bergfeld WF. The evaluation and management of acne: economic considerations. *J Am Acad Dermatol*. 1995;32 (1 pt 1):S52-S56.
2. Maddin WS, Landells IDM. Treatment of acne vulgaris and prevention of acne scarring: Canadian consensus guidelines. *J Cutan Med Surg*. 2000;4(suppl 4):2-13.
3. Stern RS. Acne therapy: medication use and sources of care in office-based practice. *Arch Dermatol*. 1996;132:776-780.
4. Webster G. Is it reasonable for dermatologists to treat acne? *Arch Dermatol*. 1996;132:819-820.
5. Bossuyt L, Bosschaert J, Richert B, et al. Lymecycline in the treatment of acne: an efficacious, safe and cost-effective alternative to minocycline. *Eur J Dermatol*. 2003;13:130-135.
6. Wessels F, Anderson AN, Kropman K. The cost-effectiveness of isotretinoin in the treatment of acne. part 3. a cost-minimisation pharmaco-economic model. *S Afr Med J*. 1999;89(7 pt 2):791-794.
7. Honein MA, Paulozzi LJ. Cost-effectiveness of oral isotretinoin. *Dermatology*. 1999;198:404-406.
8. Newton JN. How cost-effective is oral isotretinoin? *Dermatology*. 1997;195(suppl 1):10-14.
9. Hanna S, Sharma J, Klotz J. Acne vulgaris: more than skin deep. *Dermatol Online J*. 2003;9(3):8.
10. Mallon E, Newton JN, Klassen A, et al. The quality of life in acne: a comparison with general medical conditions using generic questionnaires. *Br J Dermatol*. 1999;140: 672-676.
11. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chron Dis*. 1987;27: 387-404.
12. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992;45:613-619.
13. Balkrishnan R, Rajagopalan R, Camacho FT, et al. Predictors of medication adherence and associated health care costs in an older population with type 2 diabetes mellitus: a longitudinal cohort study. *Clin Ther*. 2003;25:2958-2971.
14. Greene WH. *Econometric Analysis*. 3rd ed. Englewood Cliffs, NJ: Prentice Hall; 1997.
15. Koo J. How do you foster medication adherence for better acne vulgaris management? *Skinmed*. 2003;2:229-233.
16. Volmink J, Garner P. Systematic review of randomised controlled trials of strategies to promote adherence to tuberculosis treatment. *BMJ*. 1997;315:1403-1406.
17. Katsambas AD. Why and when the treatment of acne fails: what to do. *Dermatology*. 1998;196:158-161.
18. Draelos ZK. Patient compliance: enhancing clinician abilities and strategies. *J Am Acad Dermatol*. 1995;32(5 pt 3): S42-S48.