Impact of Comorbid Attention Deficit Disorder on the Direct Medical Costs of Treating Adults With Depression in Managed Care

Paul A. Fishman, Ph.D.; Paul E. Stang, Ph.D.; and Susan L. Hogue, Pharm.D., M.P.H.

Received Oct. 20, 2005; accepted June 26, 2006. From the Center for Health Studies, Group Health Cooperative, Seattle, Wash. (Dr. Fishman); Galt Associates, Blue Bell, and West Chester University College of Health Sciences, West Chester, Pa. (Dr. Stang); and Global Health Outcomes, GlaxoSmithKline, Research Triangle Park, N.C. (Dr. Hogue).

GlaxoSmithKline, Research Triangle Park, N.C., funded the research described in this study.

The authors acknowledge the assistance of Jane Saiers, Ph.D., in writing the manuscript. Dr. Saiers received compensation from GlaxoSmithKline for her work.

Dr. Fishman reports no other financial affiliations relevant to the subject of this article. Dr. Stang serves as a consultant to, has received grant/research support and honoraria from, and serves on the speakers or advisory boards for multiple pharmaceutical companies, including GlaxoSmithKline. Dr. Hogue is a full-time employee of GlaxoSmithKline.

Corresponding author and reprints: Paul A. Fishman, Ph.D., Center for Health Studies, Group Health Cooperative, 9750 3rd Ave. NE, Seattle, WA 98101 (e-mail: fishman.p@ghc.org).

Objective: To assess the impact of comorbid attention deficit disorder (ADD) on the direct medical costs of treating adults with depression in a mixed-model health maintenance organization.

Method: Annual mean and marginal health care costs were calculated for adults who were continuously enrolled at Group Health Cooperative during 2001 and who were diagnosed with depression, ADD, or both ADD and depression according to ICD-9-CM criteria during 2001.

Results: Of 249,874 adults continuously enrolled during 2001, 17,792 (7.1%) were diagnosed with depression, 1023 (0.4%) were diagnosed with ADD, and 454 (0.2%) were diagnosed with both depression and ADD. The mean total annual cost for an adult with a diagnosis of depression in 2001 exceeded that for the average adult enrolled in Group Health by 109% ($6029 vs. $2880). Of the $6029 mean total annual cost for treating an adult with a diagnosis of depression, $1872 (31%) was specifically attributable to depression. The presence of comorbid ADD resulted in ADD- and depression-attributed marginal costs approximately 29% higher than the costs specifically attributed to depression alone ($2418 vs. $1872). In fact, among patients with a diagnosis of ADD and depression, ADD- and depression-attributed costs approached the mean total cost of health care in the sample as a whole ($2880).

Conclusion: Depression is associated with high direct medical costs. The marginal costs of treating comorbid depression and ADD substantially exceed those of treating depression alone. These results underline the importance of considering the costs of comorbidities in estimating the economic burden of depression and developing cost-effective disease-management strategies.

(J Clin Psychiatry 2007;68:248–253)

Depression is a chronic, often disabling disease with a 12-month prevalence among U.S. adults of 6.6%, or 14 million people.[1] Given its prevalence, functional impact, and correspondingly high rates of use of medical, psychiatric, and pharmacologic care, depression is among the most costly illnesses from the payer's perspective.[2] In a recent study, mean yearly direct costs of depression in a Medicaid population comprising 284,060 patients were higher than those for other common chronic illnesses including cardiovascular disease, congestive heart failure, diabetes, acid peptic illness, asthma/respiratory illness, hypertension, and anxiety.[3]

While the substantial economic burden of depression is clear, current estimates of the direct cost of depression are insufficiently comprehensive and accurate to assist payers and providers in optimizing allocation of depression-related health care resources. The failure to account for the impact of a range of psychiatric and medical comorbidities, which are common in patients with depression,[4,5] has been identified as one impediment to the accurate estimation of depression-associated direct costs.[2,6] The presence of a chronic comorbid condition can impact the needs and prognosis of the patient with depression, the choice of treatment, and, consequently, the cost of medical care.[6,7]

Attention-deficit/hyperactivity disorder (ADHD), a condition that appears to have some neurochemical similarities with depression, is commonly comorbid with

depression in children, adolescents, and adults.[8–11] In one series of studies, the lifetime prevalence of severe depression among children with ADHD (N = 280) was 15% in females and 29% in males compared with 1% to 2% of males and females without ADHD.[8,12] Depression was also frequently comorbid with ADHD in adults, among whom the lifetime prevalence of severe depression was 36% in females and 27% in males with ADHD (N = 128) compared with 4% to 6% among males and females without ADHD.[8,13] The total direct excess cost of ADHD in the United States in 2000 was estimated at $31.6 billion.[14] Because the costs of depression and ADHD in the United States are so high and the disorders are highly comorbid, quantification of the impact of ADHD on the costs of treating patients with depression may be valuable in understanding the potential impact of intervention. The current study was undertaken to assess the impact of attention deficit disorder (ADD) on the direct medical costs of treating adults with depression among patients receiving care within a mixed-model health maintenance organization.

METHOD

Setting

This retrospective cross-sectional study was conducted at Group Health Cooperative, a nonprofit integrated health care system that provides both medical coverage and health care.[15] The second-largest consumer-governed health care organization in the United States, Group Health Cooperative and its wholly owned subsidiary, Group Health Options, Inc., offer health plans covering approximately 540,000 residents in Washington state and northern Idaho. More than 70% of members receive outpatient health care in Group Health–owned medical facilities. Group Health Cooperative is staffed by more than 600 physicians providing health care services through primary care clinics, specialty centers, and hospitals and also has contractual relationships with external health care professionals and facilities.

Sample

The sample comprised adults (aged ≥ 18 years as of January 2001) who were continuously enrolled at Group Health Cooperative during 2001. For a patient to be considered to have treated depression or ADD, a physician had to have recorded an International Classification of Disease-9th Revision-Clinical Modification (ICD-9-CM) diagnosis of depression (codes 296.20–296.26, 296.30–296.36, 311) or ADD (code 314, entire series), respectively, for that patient on at least 1 inpatient or outpatient encounter during 2001. This approach replicates methods that have been used in previous studies in this population to establish treated prevalence for a variety of chronic conditions[6] and represents the perspective of a managed care plan.

Data Sources

Diagnostic information was obtained from administrative databases maintained by Group Health Cooperative. These databases include every diagnosis made at inpatient and outpatient health care encounters regardless of whether or not patients are seen at a Group Health Cooperative–owned facility or by a Group Health Cooperative physician. These data are a key component of Group Health Cooperative's clinical improvement efforts and have been validated in a variety of research and clinical applications.[16–20]

Information on health care cost was obtained from Group Health Cooperative's electronic information system, which since January 1990 has captured and allocated health care costs for all services provided by Group Health physicians or at Group Health facilities as well as claims for covered services that enrollees receive from contracted providers or facilities. The cost-allocation system allows both the determination of costs of specific encounters and services and the aggregation of costs for individuals over time. In allocating costs to each service, procedure, pharmacy fill, or diagnostic test directly related to the delivery of health services, some costs are recorded as unweighted acquisition charges from suppliers, whereas other costs are assigned a resource intensity weight that is unique to each cost center in the delivery system. Any plan margin is included in cost allocation; however, these revenues are redistributed into the delivery system as Group Health is organized as a nonprofit consumer-governed cooperative. Costs that are excluded from the allocation include those not directly related to the delivery of health services (e.g., costs of insurance administration, marketing costs) and patient out-of-pocket costs. Group Health's cost information system is used to guide health plan resource allocation and has been used extensively for research purposes.[17–19]

Services received from providers outside the Group Health Cooperative group model constitute approximately 50% of inpatient admissions, 50% of specialty visits, and 15% of ambulatory encounters involving Group Health enrollees during a typical year. Group Health Cooperative's payments to those providers are captured in the system and allocated to enrollees. These payments, approximately 25% of total delivery system costs in a typical year, reflect the financial liability that Group Health Cooperative incurs in delivering health services to its enrollees.

Estimation of Costs

Unlike many other studies based on managed care claims data, the current analysis used the actual costs of providing health care rather than charges. Annual mean costs and marginal costs were calculated for 2001 for individuals with a diagnosis of depression only, ADD only, and both ADD and depression during 2001. Mean costs

reflect the average of all inpatient, outpatient, pharmacy, laboratory, and radiology services provided within the Group Health Cooperative delivery system or from contracted providers to Group Health Cooperative enrollees. Marginal costs reflect the resources specifically devoted to managing a particular medical condition—in this case, depression or ADD. All costs are reported in 2001 U.S. dollars. Tests of difference in unadjusted costs among groups were based on nonparametric analyses because of the non-normal distribution of health care costs.

Marginal costs were determined as previously described[20] with a weighted least-squares regression analysis to estimate the equation $Costs_i = f(age_i, sex_i, \text{chronic condition}_i)$, which specifies that costs for the i^{th} person are a function of his or her age, sex, and chronic-condition profile. The regression coefficients for a chronic condition constitute the change in cost associated with a diagnosis of that condition when other factors are held constant. To assess the marginal cost of ADD among adults with depression, we estimate an additional regression that is conditional on adults first having a diagnosis of depression. Therefore, the marginal costs of ADD for persons with depression are based on a population-based regression that identifies the marginal costs of depression and a second regression that includes the experience only of adults diagnosed with depression that identifies the marginal cost of ADD within this set of adults.

The use of standard linear methods for estimating costs was precluded because the high degree of skewness of health care costs results in regression residuals that are not identically and normally distributed. Instead, a method that involves creating a weight from the residuals of an ordinary least-squares regression to adjust for heteroskedastic error terms was used.[21,22] This weighted least-squares regression analysis provides unbiased regression coefficients and asymptotically efficient standard errors. In addition, use of the weighted least-squares regression analysis permitted health care costs to remain in nominal values. The use of nominal values eliminated the need to apply a variance-stabilizing transformation to the dependent variable and subsequently retransform regression results to obtain dollar values.

To adjust each individual's cost profile, we include a set of chronic conditions that previous research has demonstrated significantly impacts health care costs on a population basis. The specific set of conditions, and the ICD-9 codes used to identify treated prevalence, are reported in Table 1. We also adjust cost estimates for each individual's age and gender.

Table 1. ICD-9-CM Codes Used to Determine Treated Prevalence of Chronic Conditions[a]

Chronic Condition	ICD-9-CM Codes
Attention deficit disorder	314
Anxiety	293.84, 300.00, 300.02, 300.09
Back and neck pain	720, 721, 722, 723, 724, 847
Bipolar disorder	296.00, 296.01, 296.02, 296.03, 296.04, 296.05, 296.06, 296.40, 296.41, 296.42, 296.43, 296.44, 296.45, 296.46, 296.50, 296.51, 296.52, 296.53, 296.54, 296.55, 296.56, 296.60
Cardiovascular disease	402, 404, 410, 411, 413, 414, 786, 426, 427, 428, 429
Cerebrovascular disease	330, 331
Chronic obstructive pulmonary disease	496
Depression	296.20, 296.21, 296.22, 296.23, 296.24, 296.25, 296.26, 296.30, 296.31, 296.32, 296.33, 296.34, 296.35, 296.36, 311
Diabetes	250
Hyperlipdemia	272
Hypertension	401
Irritable bowel syndrome	564
Migraine	346
Obesity	278
Panic disorder	300.01
Psychotic disorder	298

[a]A 3-digit code reflects that the entire series was used in the case definition.

RESULTS

Sample

The number of adults continuously enrolled in Group Health Cooperative during 2001 was 249,874 (Table 2). Enrollees' mean age was 49.5 (SD = 17.4) years. Slightly more than half (55%) of enrollees were women.

Of the 249,874 adults continuously enrolled during 2001, 17,792 (7.1%) were diagnosed with depression, 1023 (0.4%) were diagnosed with ADD, and 454 (0.2%) were diagnosed with both depression and ADD (Table 2). The mean age of patients diagnosed with both depression and ADD (40.3 years) was lower than that of the group of all patients diagnosed with depression (50.0 years). Women comprised a smaller proportion of the group diagnosed with both depression and ADD (56.6%) than the group of all patients diagnosed with depression (70.9%). Adults diagnosed with depression were significantly ($p < .05$) older and adults diagnosed with ADD were significantly ($p < .01$) younger than the entire adult population, but the significant difference for adults diagnosed with depression is due to the large sample size more than a difference of policy relevance. Adults diagnosed with depression were significantly ($p < .01$) more likely to be female and adults diagnosed with ADD were significantly ($p < .05$) more likely to be male than the entire adult population.

Mean Costs

Mean total health care cost per patient per year for 2001 for all continuously enrolled adults in Group Health Cooperative was $2880 (SD = $7446). The comparative annual mean total cost was 109% higher ($6029; SD = $13,388; $p < .01$) in the group diagnosed with depression and 73% higher ($4979; SD = $5850; $p < .01$) in

Table 2. Characteristics of the Study Sample

Characteristic	All Adults	Adults With Depression	Adults With ADD	Adults With Depression and ADD
N	249,874	17,792	1023	454
All adults, %	100.0	7.1	0.4	0.2
Age, mean (SD), y[a]	49.5 (17.4)	50.0 (16.6)	38.5 (13.9)	40.3 (13.2)
Women, %[a]	55.0	70.9	48.3	56.6
Adults with at least 1 chronic condition, %	43.4	68.4[b]	70.2[c]	52.5[b,c]
Total health care costs, mean (SD)[a]	$2880 (7446)	$6029 (13,388)	$3928 (6332)	$4979 (5850)

[a]Differences across groups significant at $p < .01$.
[b]Excludes depression.
[c]Excludes ADD.
Abbreviation: ADD = attention deficit disorder.

the group diagnosed with both depression and ADD (Table 2). Mean total health care costs per patient per year diagnosed with ADD were 36% higher ($3928; SD = $6332; $p < .01$) than those for the average Group Health Cooperative adult enrollee. Mean costs for adults diagnosed with both depression and ADD are lower than that for all adults diagnosed with depression because the lower mean costs for adults diagnosed with ADD results in reduced overall means for the group diagnosed with both conditions (based on nonparametric analyses).

Marginal Costs

The marginal cost associated with a depression diagnosis holding age, gender, and chronic condition profile constant per patient per year for treating depression was $1872 ($p < .01$). The marginal cost per patient per year of treating ADD among adults treated with depression derived from the conditional regression was $546 ($p < .01$). Therefore, the marginal cost of treating adults diagnosed with depression and ADD is the sum of the marginal costs of treating depression and the marginal cost of treating ADD among adults with depression or $2418.

DISCUSSION

The results of this study involving approximately 250,000 adults continuously enrolled in Group Health Cooperative during 2001 confirm previous results demonstrating that depression is associated with high direct medical costs. However, this study further documents that the incremental costs of treating comorbid depression and ADD substantially exceed those of treating depression alone. The mean total annual cost for an adult with a diagnosis of depression in 2001 was more than double that of the average adult enrolled in Group Health ($6029 vs. $2880). Of the $6029 mean total annual cost for treating an adult with a diagnosis of depression, $1872 (31%) was specifically attributable to depression. The presence of comorbid ADD resulted in ADD- and depression-attributed costs that were approximately 29% higher than the costs specifically attributed to depression alone ($2418 vs. $1872). In fact, among patients with a diagnosis of ADD and depression, ADD- and depression-attributed health care costs approached the mean total cost of health care in the general Group Health population ($2880). These data suggest that comorbid ADD substantially increases the direct medical costs of patients with depression and underscore the importance of considering the costs of comorbidities in estimating the economic burden of depression. Failure to recognize these combinations of factors may reduce the effectiveness of any intervention and misdirect cost-effective disease-management strategies. Furthermore, analyses that examine the relative costs of interventions for depression and ADD will be misspecified if the joint cost effect of these 2 illnesses is not taken into consideration.

Insofar as the comorbidity between depression and ADD arises from factors such as common pathophysiology and common risk factors, interventions that affect common pathophysiologic features or measures that modify common risk factors have the potential to improve both diseases and may have additive or synergistic clinical and cost-saving benefits. The potential that medications used to treat one comorbidity may impact (improve or worsen) comorbid illness should also be carefully considered. For example, overall medication costs for patients with comorbid depression and ADD could be reduced by using a treatment approach or medication that is effective for depression and the symptoms of ADD.

A strength of this study is its representativeness resulting from its large sample size and population-based scope. Previous research suggests that the population of patients enrolled at Group Health is representative of the community with respect to age, sex, and race.[16] Accurate cost estimation, another strength of the study, was enhanced through the use of true costs that directly reflect use of resources in the health care system rather than charges to estimate costs or to reflect the financial impact. Maximization of data capture by conducting the study in an integrated health care delivery system also constitutes a strength of this investigation.

The study should also be interpreted in the context of its limitations. First, the sample, while generally representative of the communities served by Group Health, is not

representative of the entire United States. Those in the highest and lowest income brackets are underrepresented in the Group Health database, and Group Health enrollees are slightly more educated than those in the community at large. Also, while the results are probably generalizable to health maintenance organizations that are structured similarly to Group Health or deliver health care for these illnesses in a similar way, they may not generalize to all health care delivery organizations. Possibly, as care for depression in this well-studied system has been optimized, costs in another system could be higher.

Second, several factors may have contributed to underestimation of the costs of treating ADD and/or depression. Enrollees were considered to have treated ADD and/or depression only if a diagnosis for them was recorded during 2001. Patients in the database with ADD and/or depression who received a diagnosis prior to 2001 but not during 2001 were not identified as having either illness. The study did not capture depression- or ADD-attributed costs incurred in 2001 by enrollees who received ongoing treatment for these illnesses but whose 2001 records did not include a diagnosis of them.

In addition, the study included only adult patients and therefore did not capture costs of childhood depression and ADD. ADD is common in childhood, and the prevalence of depression is elevated in those with ADD compared with those without ADD in children as in adults.[8–12] Only a portion of those with depression and/or ADD is clinically detected. In the current study, those with unrecognized/untreated depression or ADD would have been included in the nonaffected comparison group, and any influence of these disorders on direct costs would have accrued to the nonaffected comparison group. This potential bias is a conservative one as it would have been expected to have increased costs in the comparison group and attenuate any differences between groups.

The fact that the 3 study cohorts were not mutually exclusive (i.e., those with depression and ADD were also included in both the ADD and depression cohorts) further biased results conservatively in that it decreased the differences between groups. However, the approach taken yields results more generalizable to cohorts of all patients with depression and all patients with ADD rather than just subsets. This study also did not capture indirect costs (i.e., those attributable to lost productivity or quality of life), the addition of which would probably have substantively increased the marginal costs of both depression and ADD. Therefore, the current study probably underestimates the true impact of these conditions.

Our cost estimates for adults with depression and ADD were adjusted for a set of chronic conditions that have been shown to explain a significant amount of health care costs among adults. We did not explicitly adjust our analyses for relative severity of either depression or ADD because severity measures available to us also depend entirely on secondary data such as frequency of diagnoses or prescription medication profile. Other studies have applied similar approaches to measuring disease severity, but we chose not to because of concerns that we would capture practice pattern variation or individual patient choices as much as relative disease severity.

Our analyses are not intended to address either economic or clinical causality of ADD for the experience of adults diagnosed with depression. Our goal was to take advantage of data for a large managed care population to assess the cost relationship among adults with comorbid depression and ADD. These data provide insight into the manner in which comorbid ADD impacts the cost of treating and managing depression among adults from the perspective of a managed care plan.

In conclusion, these data from a large cohort of patients enrolled in a nonprofit mixed-model health maintenance organization show that depression is associated with high direct medical costs and that the marginal costs of treating comorbid depression and ADD exceed by approximately 29% the marginal cost of treating depression alone. These data extend previous research demonstrating that the presence of comorbidities can affect the therapeutic needs and prognosis of patients with chronic conditions.[6] The costs of comorbidities such as ADD need to be taken into account in assessing the economic burden of depression and developing optimal strategies for its management.

REFERENCES

1. Kessler RC, Berglund P, Demler O, et al. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). JAMA 2003;289:3095–3105
2. Bloom BS. Prevalence and economic effects of depression. P&T Digest: Depression. Available at: www.ptjournal.com/supplements/ptd_depression/PTD_depression_0406.pdf. Accessed Feb 20, 2005. Yardley, Pa: Medimedia; 2004
3. Garis RI, Farmer KC. Examining costs of chronic conditions in a Medicaid population. Manag Care 2002;11:43–50
4. Enns MW, Swenson JR, McIntyre RS, et al. Clinical guidelines for the treatment of depressive disorders, 7: comorbidity. Can J Psychiatry 2001; 46(suppl 1):77S–90S
5. Katon WJ. Clinical and health services relationships between major depression, depressive symptoms, and general medical illness. Biol Psychiatry 2003;54:216–226
6. Bruce ML, Wells KB, Miranda J, et al. Barriers to reducing burden of affective disorders. Ment Health Serv Res 2002;4:187–197
7. Williams A, Botti M. Issues concerning the ongoing care of patients with comorbidities in acute care and post-discharge in Australia: a literature review. J Adv Nurs 2002;40:131–140
8. Biederman J. Impact of comorbidity in adults with attention-deficit/hyperactivity disorder. J Clin Psychiatry 2004;65(suppl 3):3–7
9. Barkley RA. Major life activity and health outcomes associated with attention-deficit/hyperactivity disorder. J Clin Psychiatry 2002;63 (suppl 12):10–15
10. Fischer M, Barkley RA, Smallish L, et al. Young adult follow-up of hyperactive children: self-reported psychiatric disorders, comorbidity, and the role of childhood conduct problems and teen CD. J Abnorm Child Psychol 2002;30:463–475
11. Waxmonsky J. Assessment and treatment of attention deficit hyperactivity disorder in children with comorbid psychiatric illness. Curr Opin Pediatr 2003;15:476–482

12. Biederman J, Mick E, Faraone SV, et al. Influence of gender on attention deficit hyperactivity disorder in children referred to a psychiatric clinic. Am J Psychiatry 2002;159:36–42
13. Biederman J, Faraone SV, Spencer T, et al. Gender differences in a sample of adults with attention deficit hyperactivity disorder. Psychiatry Res 1994;53:13–29
14. Birnbaum HG, Kessler RC, Lowe SW, et al. Costs of attention deficit-hyperactivity disorder (ADHD) in the US: excess costs of persons with ADHD and their family members in 2000. Curr Med Res Opin 2005;21: 195–206
15. Group Health Cooperative. My Group Health. Available at: www.ghc.org. Accessed Jan 20, 2005
16. Fishman P, Von Korff M, Lozano P, et al. Chronic care costs in managed care. Health Aff (Millwood) 1997;16:239–247
17. Wagner EH, Sandhu N, Newton KM, et al. Effect of improved glycemic control on health care costs and utilization. JAMA 2001;285:182–189
18. Simon G, Fishman P. Cost Implications of initial antidepressant selection in primary care. Pharmacoeconomics 1998;13:61–70
19. Fishman PA, Khan ZM, Thompson EE, et al. Health care costs among smokers, former smokers and never smokers in an HMO. Health Serv Res 2003;38:733–749
20. Lozano P, Fishman P, VonKorff M, et al. Health care utilization and cost among children with asthma who were enrolled in a health maintenance organization. Pediatrics 1997;99:757–764
21. Judge GG, Griffiths WE, Hill RC, et al. The Theory and Practice of Econometrics. New York, NY: John Wiley & Sons; 1985
22. Kennedy P. A Guide to Econometrics. 3rd ed. Cambridge, Mass: MIT Press; 1992