Published in final edited form as:

J AAPOS. 2007 October ; 11(5): 480–487.

Patterns of Eye Care Use and Expenditures Among Children with Diagnosed Eye Conditions

Michael Ganz, Ziming Xuan, and David G. Hunter

Abstract

Purpose: Little is known about the use and expenditure patterns of children's eye care services and about possible disparities in care for those children. This report describes the use and expenditure patterns of eye and non-eye care services for children < 18 years old in the United States.

Methods: Use and expenditure levels were estimated using self-reported information from the nationally representative Medical Expenditure Panel Surveys for 48,304 members of randomly selected households in the United States that were < 18 years old from 1996 to 2001. Means presented for children with and without diagnosed eye conditions were adjusted for child and family characteristics using generalized linear models.

Results: Children with diagnosed eye conditions had higher use and expenditure levels than children without such conditions. Families of children with diagnosed eye conditions incurred higher out-of-pocket expenditures. Black children and children living below 400% of the federal poverty level had lower use and expenditure levels indicating they received fewer and less intensive services.

Conclusions: Children with diagnosed eye conditions experienced higher overall use of health care. Certain groups of children appear to be underserved. To plan for future delivery of children's eye and vision care services and to assess progress toward Healthy People 2010 goals, estimates of use and expenditure patterns stratified by socioeconomic factors will be needed.

Introduction

Visual impairments and other conditions of the eye are among the 10 most frequent causes of disability in America^{1, 2}, affecting about 80 million people per year (about one-third of the U.S. population).³ The cost of treating these conditions is at least \$22.5 billion in direct medical costs and \$16.1 billion in indirect costs per year.¹ It is estimated that approximately 25 per 1,000 children < 18 years old are blind or visually impaired.^{1, 4} About 2% of children entering first grade, and about 15% of children entering high school are nearsighted.⁵ Recognizing that visual impairments can lead to increased need for special educational, vocational, and social services, the Department of Health and Human Services has responded by publishing 10 vision-related goals in the Healthy People 2010 Objectives, including two that are specifically for children: Objective 28-2 (to increase the proportion of preschool children aged ≤ 5 years who receive vision screening) and Objective 28-4 (to reduce blindness and visual impairment in children and adolescents aged ≤ 17 years).¹

Children are a vulnerable and understudied group. In response to recent research priorities articulated by the National Eye Institute Health Services Working Group, in particular about the epidemiology and patterns of eye health care use for children,^{6, 7} we report here on the annual use and expenditure patterns of children's eye and vision related services. Given the

changing landscape of health care financing these data can assist policy makers in allocating scarce health care resources to where they are most needed⁷ and to help increase public awareness of the burdens of eye conditions and possible disparities in use and expenditures for children.

Methods

This study was approved by the Harvard School of Public Health Human Subjects Committee and met all requirements of the United States Health Insurance Portability and Accountability Act.

Sources of Data, Selection, and Classification of Cases

Information on the construction of the data used for this study has been presented elsewhere.⁸ Briefly, we used the 1996–2001 Medical Expenditure Panel Survey (MEPS), which is a national probability survey conducted by the Agency for Health Care Research and Quality about the financing and use of medical care in the United States. The MEPS contains detailed information on sociodemographic factors, insurance coverage, and health characteristics for the U.S. civilian, non-institutionalized population⁹ and we used it to construct measures of child and family demographics, health status, and parental employment. The MEPS also contains information on health care use and expenditures. Respondents were interviewed every 4 months, to reduce recall bias, over a 30-month period to obtain information that covers two consecutive calendar years.

The MEPS files contain 3-digit ICD9 diagnosis codes for each health care event. We used the diagnosis codes recorded in the MEPS files to identify children with diagnosed eye conditions as those with codes in the range 360–369, 371–379, 743, 870, 871, 918, 921, 930, and 940 (see Table 1 and elsewhere⁸ for further details). In order to increase sample size, data from 1996 through 2001 were pooled. Of 48,304 child-year observations available in these files, 2,813 (5.8%) had at least one diagnosed eye condition. A large number of cases (N=887) were due to ICD9 diagnosis code 372 (disorders of the conjunctiva), which mainly contains conjunctivitis. Since pediatricians primarily treat conjunctivitis, while specialists primarily treat other eye conditions, analyses were performed with and without this conjunctivitis-related diagnosis group.^{10–12}

The term “diagnosed eye condition” is used here to mean any type of diagnosed, treated, or medically-identified eye or vision condition or problem (whether corrected or not) that corresponds to any one of the diagnosis codes listed above. Medical conditions were reported by survey respondents and were coded to ICD9 codes by professional coders. The MEPS supplemented and validated information on medical care events by obtaining data directly from providers and pharmacies. Since the presence of a diagnosis code in a MEPS data file depended on some health care interaction, the modifier “diagnosed” is used. The MEPS also included a series of questions that queried the level of self-reported vision impairments, and children who can not read newsprint, can not recognize people, or are blind are denoted as “Self-Reported Impaired Vision/Blind” in the analyses presented below. Starting in 2000 the MEPS also included a measure of a child's special health care needs status. A child with special health care needs was defined as a child, ≤ 18 years old, with activity limitations who was or currently needs more health care or other services than is usual for most children of the same age.¹³ Children with special health care needs were identified using questions developed by the Child and Adolescent Health Measurement Initiative under coordination by the Foundation for Accountability.^{13, 14} Because there is some evidence^{15, 16} of a correlation between eye problems and chronic systemic disease that can also define a child as one with special health care needs, we assessed the sensitivity of our results by estimating models that included a

special health care needs variable and other measures of chronic conditions. Our main results were unchanged after adjusting for special health care needs or for chronic conditions.

In addition, since there is evidence from previous work on the same sample that underprivileged children may be under-diagnosed and/or under-treated,⁸ we also examined use and expenditure levels stratified by race (black/white) and family income (below/above 400% Federal Poverty Level).

Use and Expenditure Measures

We created variables that capture the yearly use levels and expenditures of visits to the emergency department, of inpatient hospital stays, of outpatient visits, of visits to office-based providers, of the number of drug prescriptions filled, and expenditures on corrective lenses. Records for home health events and “other” events (such as ambulance services, disposable and durable medical equipment and supplies, as well as other miscellaneous items or services that were obtained, purchased or rented during the year) lacked diagnosis information and therefore are not separately analyzed here (although total expenditures encompassing all categories of care are analyzed). Events that were either performed by an eye-care provider or linked to an eye related condition (as defined above) were designated as eye related services.

By definition, we expected that children without diagnosed eye conditions would not have experienced eye-related services, yet 2,256 cases (4.9%) without diagnosed eye conditions had use/expenditures for office-based (2,240 observations) and outpatient services (20 observations). These non-zero values could be explained, in part, by routine eye examinations. To simplify the analyses, use and expenditure values for those children were replaced with zero. This substitution had no substantial impact on the results presented here (unadjusted means were virtually unchanged; not shown here).

The MEPS files recorded total payments (expenditures) and payments made by third parties (we did not compute the value of uncompensated care). We defined family out-of-pocket expenditures as the difference between total expenditures and payments made by third parties. We also defined the ratio of out-of-pocket expenditures to total expenditures as the result of dividing family out-of-pocket expenditure by total expenditures (within category). All expenditure values for the years 1996–2000 were inflated to 2003 dollars using the all item consumer price index.¹⁷

Data Analysis

In order to control for potential confounding, the associations between having a diagnosed eye condition and the use and expenditure measures were estimated using multiple regression models that controlled for child and family characteristics. In particular, we estimated a series of generalized linear models to assess the impact of having a diagnosed eye condition on use and expenditure levels.¹⁸⁻²¹ All analyses adjusted for the both the multiple entries for some children as well as the complex stratified multistage survey design of the MEPS^{22, 23} using Stata statistical software (Stata Corporation: College Station, Texas) and we defined statistical significance as $p \leq 0.05$. In the tables that follow, we present the use and expenditure values that were predicted by the regression models (unadjusted means are available in Supplement 1 available at www.jaapos.org). These predicted values represent the average use and expenditure values that were adjusted for child and family characteristics associated with these outcomes. Full regression results are available in Supplement 2 available at www.jaapos.org or from the authors.

We used a multiple imputation technique²⁴ to fill in all missing data points rather than delete cases missing data, which would otherwise result in bias.^{25, 26} Conventional survey analyses,

as outlined above, were conducted using the multiply imputed data sets. Standard procedures were used to combine regression result and to perform valid statistical tests with the multiply imputed data.^{25, 26} Further information on the imputation process have been presented previously⁸ and are available upon request from the authors, as are copies of the imputed data files.

Results

Approximately 6.8% (95% confidence interval [CI] = 6.6% to 7.2%) of children had some type of diagnosed eye condition and approximately 4.7% (95% CI = 4.4% to 5.0%) of children had some type of diagnosed eye condition other than one exclusively related to disorders of the conjunctiva (most likely conjunctivitis). Table 2 displays the population-weighted descriptive statistics of the study sample (along with the unweighted count of cases). At the population level, older children, non-White children, Hispanic children, and children in very good to excellent self-reported health were statistically significantly less likely to have a diagnosed eye condition than younger, white, non-Hispanic, and children in poor health. Children with an ambulatory care sensitive condition,²⁷ children whose mothers had at least a high school education, children with a usual source of care, and children living in the South were significantly more likely to have a diagnosed eye condition than children without an ambulatory care sensitive condition, children whose mothers had less than a high school education, children without a usual source of care, and children in regions other than the South. Children who had other family members with diagnosed eye conditions were significantly more likely to have a diagnosed eye condition themselves than children lacking family members with diagnosed eye conditions.

Table 3 displays the total, non-eye and eye-related regression-adjusted average annual use levels for emergency (number of visits), inpatient (number of discharges), office-based (number of visits), and outpatient services (number of visits) as well as the number of prescriptions filled. Children with diagnosed eye conditions used statistically significantly more eye-related and non-eye related services than children without such conditions. Results were basically unchanged after excluding those children whose only diagnosis was related to disorders of the conjunctiva (not shown). Results were also unchanged after controlling for the presence of systemic disease or for special health care needs status (not shown).

Table 4 displays the regression-adjusted annual average expenditures for children with and without diagnosed eye conditions for emergency, inpatient, office-based, and outpatient services as well for prescriptions. Total expenditures, which include home health and “other” types of services, and corrective lens expenditures are also displayed. Consistent with the results in Table 3 for use, children with diagnosed eye conditions tend to have higher overall levels of expenditures for all types of services, for corrective lenses, and for emergency, inpatient, office-based, outpatient, and prescription drug services. By definition, children with diagnosed eye related conditions have higher expenditure levels for eye-related services. However, children with diagnosed eye conditions also have higher expenditure levels for non-eye related services. After excluding those children whose only diagnosis was related to disorders of the conjunctiva, we found that total health care expenditures and corrective lens expenditures were higher and slightly lower for non-eye related expenditure (not shown).

Table 5 displays the average annual regression-adjusted expenditure levels by source of payment as well as the ratio of out-of-pocket and third party expenditures to total expenditures. Children with diagnosed eye conditions not only incurred higher costs (Table 4) but also incurred consistently higher family out-of-pocket costs. Consistent with the fact that about 90% of the children were covered by some insurance arrangement during some part of the year, the ratio of expenditures paid by another party to total expenditures is greater than the ratio of

family out-of-pocket expenditures to total expenditures for all categories of services and for both children with and without diagnosed eye conditions excluding glasses and contact lens expenditures.

We also present, in Table 6 the ratios of Black to White race and lower income to higher income (below/above 400% Federal Poverty Level) predicted annual expenditure levels. Controlling for all of the same child and family characteristics as in the previous analyses, we find that expenditure levels for Black children tended to be lower, as indicated by a ratio less than 1.0, than for white children (except for emergency services and prescriptions for eye related services), sometimes by as much as a 1:2 ratio. Children living below the 400% Federal Poverty Level have expenditure levels that are smaller than for children at or above the 400% Federal Poverty Level except for emergency and inpatient services, for which the expenditure levels were twice as high and almost 50% higher, respectively, for children below 400% Federal Poverty Level. Use patterns (not shown) display similar disparities by race and income.

Discussion

Uncorrected vision impairment and other untreated eye conditions can adversely impact quality of life. For children, vision is critical for the acquisition of skills that will be important for future human capital investments. Although the patterns of use and expenditures for adults are relatively well known,²⁸⁻³³ less is known about eye-care and vision services for children. According to the 1971–1972 National Health and Nutrition Examination Survey, depending on age, about 28 per 1,000 children 12–17 years old needed eye care and about 20 per 1,000 children were under such care.³⁴ According to the 1979 National Health Interview Survey, children <17 years experienced about 133 eye care visits per 100 persons in the past year (compared to 149 for all ages).³⁵ About 1% of 3 year-olds wore corrective lenses, but about 46% of females and about 29% of males aged 19–21 years wore corrective lenses. About 19% of the total eye-care visits in 1979 were by children <17 years, with boys experiencing about 21% of the visits and girls 18%. About 19% of visits by Black patients were by children <17 years old (16% for White patients). More recently, Kemper, using the 1998 Medical Expenditure Panel Survey and the 2000 National Health Interview Survey, estimated that 25% of the 52.6 million children aged 6–18 years had corrective lenses.³⁶ Girls were more likely to have corrective lenses, and among Black or Hispanic children, the insured were more likely to have corrective lenses than the uninsured. Hodges and Berk reported on the 1994 Robert Wood Johnson Access to Care Survey and found that 2% of children had an unmet need for eyeglasses (5.3% for the general population).³⁷

Other than the studies cited here, which have focused on corrective lenses, we could not identify any more recent reports of eye-care use/expenditure patterns for children.* The results of use and expenditure patterns, especially those stratified by socioeconomic factors, that we have presented above are needed to help policy-makers and clinicians plan for future delivery of children's eye and vision care services and assess progress toward Healthy People 2010 goals.

This paper has presented a method for using a large and ongoing nationally representative survey of the health care experiences of United States residents — the Medical Expenditure Panel Survey — to describe the health care experiences of children < 18 years old with diagnosed or treated eye conditions. The MEPS provides information on the use of services, insurance status, employment factors, and health measures for sampled household members.

We searched Medline using the following strategy: (child and (eye or vision) and (utiliz* or expend* or cost)) and (United States). We found no articles presenting nationally representative statistics for both utilization and expenditure patterns for children that reported on data more recent than 1990.

This wealth of linked information provides an opportunity to conduct research that can provide a fuller understanding of children's use and expenditure patterns for eye care and non-eye care services

As expected, children with diagnosed eye conditions had higher overall and higher eye-related use and expenditure levels. This is consistent with previously reported findings reported above. However, we also found that children with diagnosed eye conditions had higher use and expenditure levels for non-eye related services, which we believe is a novel set of findings. These relationships were robust to controls for systemic and chronic illness, which may be correlated with eye conditions. We also found that average expenditures tended to be higher after excluding children whose only diagnosis was related to disorders of the conjunctiva, which is consistent with the increased likelihood that those remaining children are seen strictly by specialists rather than also by primary care physicians.

Not only do children with diagnosed eye conditions have increased expenditure levels, but families of those children also incurred higher out-of-pocket expenditures. We also found evidence of socioeconomic disparities. Black children and children living below 400% Federal Poverty Level had lower use and expenditure levels indicating, even after controlling for other socioeconomic and health measures, indicating that those children are receiving fewer and less intensive services. The generally higher use/expenditure levels for emergency department and inpatient services for black and less well-off children implies that those children are seeking both their eye and non-eye related services in settings rather than office-based or outpatient settings. Previously we found that white children and children living in higher income families had a higher likelihood of having a diagnosed condition indicating possible differential access to eye care services.⁸ Our additional findings reported here on use and expenditure disparities suggest not only some degree of under-diagnosis but also under-treatment among certain underprivileged groups of children. Given that it is unlikely that the eye conditions are inherently less common or less severe among certain groups, our findings on access disparities most likely confirm recent evidence from the National Health Interview Survey that most of the race/ethnicity and economic differences in health are due to disparities in access to care and screening.³⁸ This is further supported by other evidence that income, access to care, and insurance are highly correlated.⁴

Although children with diagnosed eye and vision conditions can be identified in the MEPS and can be linked to their use of medical care in a straight-forward and reproducible way, there are a number of limitations to this project. Although the quantitative information we present on use and expenditure patterns are important for policy purposes, the MEPS did not contain information on the quality of the eye-related and non-eye-related services the children received, therefore we caution readers from making inferences about quality of services. Furthermore, even though we do find differences in use and expenditures between income groups, we do not suggest, necessarily, that the use and/or expenditure levels represent optimal levels for either group.

The identification of diagnosed eye conditions was not based on screening examinations, but rather on the presence of diagnosis codes and other information indicative of a condition.⁸ Although our estimates of the use and expenditure levels for the children identified here are unlikely to be biased (subject to the representativeness and quality of the MEPS data), they probably underestimate the number of children with eye conditions, and should be considered as lower use and expenditure estimates. Furthermore, since the presence of a diagnosis in the MEPS is mostly dependent on a health care event, there may be a tendency to identify more severe cases because a problem has to be serious enough to be diagnosed, possibly upwardly biasing the estimates of mean expenditure levels. However, since the focus of this paper is to examine the distribution of children's use and expenditure patterns, the broad definition of

having an eye condition coupled with the health services information in the MEPS, is sufficient to indicate a diagnosed problem and a past or future need for some type of care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

This project was partially supported by the National Eye Institute (grant number R03 EY015431) (Ganz and Xuan) and a Research to Prevent Blindness Walt and Lily Disney Award for Amblyopia Research (Hunter). The contents are solely the responsibility of the authors and do not necessarily represent the official views of the National Eye Institute.

References

1. U.S. Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health. 2nd ed. Washington, DC: U.S. Government Printing Office; 2000.
2. Verbrugge LM, Patrick DL. Seven chronic conditions: Their impact on U.S. adults' activity levels and use of medical services. *American Journal of Public Health* 1995;85:173–182. [PubMed: 7856776]
3. Tielsch JM, Sommer A, Witt K, Katz J, Royall RM. Blindness and visual impairment in an American urban population. The Baltimore Eye Survey.[comment]. *Archives of Ophthalmology* 1990;108:286–290. [PubMed: 2271016]
4. Centers for Disease Control and Prevention (CDC). Visual impairment and use of eye-care services and protective eyewear among children—United States, 2002. *Morbidity and Mortality Weekly Report* 2005;54:425–429. [PubMed: 15889010]
5. Zadnik K. The Glenn A. Fry Award Lecture (1995). Myopia development in childhood. *Optometry & Vision Science* 1997;74
6. National Eye Institute. Vision Research—A National Plan: 1999–2003. Bethesda, MD: 2001.
7. National Eye Institute. Strategic Plan on Reducing Health Disparities FY 2000–2004. Oct. 2004 <http://www.nei.nih.gov/resources/strategicplans/disparities.asp#health>. Accessed February 3, 2006, 2006
8. Ganz ML, Xuan Z, Hunter DG. Prevalence and correlates of children's diagnosed eye and vision conditions. *Ophthalmology* 2006;113:2298–2306. [PubMed: 16962175]
9. Cohen, SB.; DiGaetano, R.; Goskel, H.; Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey. Methodology report #5. Estimation procedures in the 1996 MEPS Household Component. AHRQ Pub. No. 99-0027 http://www.meps.ahrq.gov/papers/mr5_99-0027/mr5.htm. Accessed July 12, 2005
10. Rose PW, Ziebland S, Harnden A, Mayon-White R, Mant D. Why do general practitioners prescribe antibiotics for acute infective conjunctivitis in children? Qualitative interview with GPs and a questionnaire survey of parents and teachers. *Family Practice* 2006;23:226–232. [PubMed: 16339771]
11. Sheikh A, Hirwitz B. Topical antibiotics for acute bacterial conjunctivitis: Cochrane systematic review and meta-analysis update. *British Journal of General Practice* 2005;55:962–964. [PubMed: 16378567]
12. Wirbelauer C. Management of the red eye for the primary care physician. *American Journal of Medicine* 2006;119:302–306. [PubMed: 16564769]
13. Center for Financing AaCT. MEPS HC-050: 2000 Full Year Consolidated Data File. Agency for Healthcare Research and Quality; Rockville, MD: 2003.
14. Bethel CD, Read D, Stein REK, Blumberg SJ, Wells N, Newacheck PW. Identifying children with special health care needs: Development and evaluation of a short screening instrument. *Ambulatory Pediatrics* 2002;2:38–48. [PubMed: 11888437]
15. Hunter DG, Ellis FJ. Prevalence of systemic and ocular disease in infantile exotropia: comparison with infantile esotropia. *Ophthalmology* 1999;106:1951–1956. [PubMed: 10519591]

16. Logan NS, Gilmartin B, Marr JE, Stevenson MR, Ainsworth JR. Community-based study of the association of high myopia in children with ocular and systemic disease. *Optom Vis Sci* 2004;81:11–13. [PubMed: 14747755]
17. Congressional Budget Office. The Budget and Economic Outlook: An Update. Aug. 2003 <http://www.cbo.gov/showdoc.cfm?index=4493&sequence=3>. Accessed January 4, 2005
18. Blough DK, Madden CW, Hornbrook MC. Modeling risk using generalized linear models. *Journal of Health Economics* 1999;18:153–171. [PubMed: 10346351]
19. Dodd S, Bassi A, Bodger K, Williamson P. A comparison of multivariable regression models to analyse cost data. *J Eval Clin Pract* 2006;12:76–86. [PubMed: 16422782]
20. Manning WG, Mullahy J. Estimating log models: to transform or not to transform? *J Health Econ* 2001;20:461–494. [PubMed: 11469231]
21. Mullahy J. Much ado about two: reconsidering retransformation and the two-part model in health econometrics. *J Health Econ* 1998;17:247–281. [PubMed: 10180918]
22. Center for Financing, Access and Cost Trends. MEPS HC-036: 1996-2001 pooled estimation file. Dec. 2003 <http://www.meps.ahrq.gov/PUFFiles/H36/H36U01doc.htm>. Accessed February 2, 2006
23. Korn EL, Graubard BI. Simultaneous testing of regression coefficients with complex survey data: use of Bonferroni t-statistics. *American Statistician* 1990;44:270–276.
24. Raghunathan TE, Lepkowski JM, van Hoewyk J, P.W. S. A multivariate technique for multiply imputing missing values using a sequence of regression models. *Survey Methodology* 2001;27:85–95.
25. Rubin DB. Multiple imputation after 18+ years. *Journal of the American Statistical Association* 1996;91:473–489.
26. Schafer JL. Multiple imputation: A primer. *Statistical Methods in Medical Research* 1999;8:3–15. [PubMed: 10347857]
27. Billings J, Zeitel L, Lukomnik J, Carey TS, Blank AE, Newman L. Impact of socioeconomic status on hospital use in New York City. *Health Aff (Millwood)* Spring;1993 12:162–173. [PubMed: 8509018]
28. Salm M, Belsky D, Sloan FA. Trends in cost of major eye diseases to Medicare, 1991 to 2000. *Am J Ophthalmol* 2006;142:976–982. [PubMed: 17157582]
29. Ross JS, Bradley EH, Busch SH. Use of health care services by lower-income and higher-income uninsured adults. *JAMA* 2006;295:2027–2036. [PubMed: 16670411]
30. Tay T, Rochtchina E, Mitchell P, Lindley R, Wang JJ. Eye care service utilization in older people seeking aged care. *Clin Experiment Ophthalmol* 2006;34:141–145. [PubMed: 16626428]
31. Kuo S, Fleming BB, Gittings NS, et al. Trends in care practices and outcomes among Medicare beneficiaries with diabetes. *Am J Prev Med* 2005;29:396–403. [PubMed: 16376702]
32. Brown AF, Jiang L, Fong DS, et al. Need for eye care among older adults with diabetes mellitus in fee-for-service and managed Medicare. *Arch Ophthalmol* 2005;123:669–675. [PubMed: 15883287]
33. Ellwein LB, Urato CJ. Use of eye care and associated charges among the Medicare population: 1991-1998. *Arch Ophthalmol* 2002;120:804–811. [PubMed: 12049587]
34. Ganley JP, Roberts J. Eye conditions and related need for medical care. *Vital & Health Statistics - Series 11: Data From the National Health Survey* 1983:1–69.
35. Poe GS. Eye care visits and use of eyeglasses or contact lenses. United States, 1979 and 1980. *Vital & Health Statistics - Series 10: Data From the National Health Survey* 1984:1–60.
36. Kemper, AR.; Bruckman, D.; Freed, GL. Paper presented at: Pediatric Academic Societies' Annual Meeting. Seattle, WA: Prevalence and distribution of corrective lenses among school-aged children.
37. Hodges LE, Berk ML. Unmet need for eyeglasses: results from the 1994 Robert Wood Johnson Access to Care Survey. *Journal of the American Optometric Association* 1999;70:261–265. [PubMed: 10457703]
38. Agency for Healthcare Research and Quality. 2005 National Healthcare Disparities Report. Rockville, MD: U.S. Department of Health and Human Services; Dec. 2005 AHRQ Publication No. 06-0017

Table 1

International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9) Codes Used to Define Diagnosed Eye/Vision Conditions

360 – Disorders of The Globe
361 – Retinal Detachment
362 – Retinal Disorders
363 – Choroidal Disorders
364 – Disorders of the Iris/Ciliary
365 – Glaucoma
366 – Cataract
371 – Corneal Opacity and other Disorder of the Cornea
377 – Disorders of the Optic Nerve
743 – Congenital Eye Anomalies
367 – Refractive Disorders (includes amblyopia)
368 – Visual Disturbances
369 – Blindness And Low Vision
372 – Disorders Of Conjunctiva
373 – Inflammation of the Eyelid
374 – Disorders of the Eyelid
375 – Disorders of the Lacrimal System
376 – Disorders of the Orbit
378 – Strabismus
379 – Other Disorders of the Eye
870 – Open Wound to the Ocular Adnexa
871 – Open Wound to the Eyeball
918 – Superficial Injury to the Eye and Adnexa
921 – Contusion of the Eye and Adnexa
930 – Foreign Body on External Eye
940 – Burn Confined to Eye and Adnexa

Table 2

Distribution of Child and Family Characteristics by Diagnosed Eye/Vision Condition, Children < 18 Years Old in the United States, 1996–2001

	Without Diagnosed Eye/Vision Conditions (Unweighted N=45,491)		With Diagnosed Eye/Vision Conditions (Unweighted N=2,813)	
	%	SE	%	SE
Demographics:				
Age 0-8	49.3	0.5	57.4	1.3
Age 9-17	50.7	0.5	42.6	1.3
Black	16.9	0.9	10.1	0.9
White	77.8	0.9	85.7	1.0
Other Race	5.3	0.4	4.2	0.6
Hispanic	16.5	1.1	11.2	1.1
Female	48.6	0.4	49.9	1.3
Midwest	23.1	1.5	29.4	2.2
Northeast	17.8	1.1	18.2	1.5
South	34.7	1.7	30.3	2.0
West	24.4	1.7	22.0	2.3
Metropolitan Statistical Area	81.4	1.2	81.3	1.6
Income < 125 Federal Poverty Level (FPL)	24.4	0.7	17.5	1.1
Income 125-399 FPL	49.2	0.6	48.2	1.4
Income ≥ 400 FPL	26.3	0.7	34.3	1.6
Mother Graduated College	30.0	0.7	40.6	1.5
Mother Graduated High School	53.7	0.7	50.7	1.5
Mother Working	71.0	0.7	74.1	1.2
Health Status:				
Ambulatory Care Sensitive Condition	6.8	0.2	9.1	0.8
Excellent-Very Good Health Status	72.3	0.6	68.2	1.3
Blind/Impaired in Both Eyes	0.8	0.1	2.1	0.3
Other Family Members with Eye/Vision Conditions	10.3	0.4	35.4	1.6
Excellent-Very Good Mental Health Status	76.0	0.6	77.8	0.6
Access and Insurance:				
Has a Usual Source of Care	90.0	0.4	94.9	0.6
Private Insurance	67.5	0.8	77.9	1.3
Public Insurance	21.8	0.7	16.0	1.0
Uninsured	9.8	0.4	5.3	0.6

Notes: All estimates and standard errors (SE) are corrected for the complex survey design of the MEPS and for multiple imputation of missing data. Source of data: Medical Expenditure Panel Survey.

Table 3

Regression Adjusted Annual Average Use of Services by Types of Service and Events for Children < 18 Years Old in the United States, 1996–2001

Types of Service	Regression Adjusted Utilization (95% CI)	
	Without Diagnosed Eye/Vision Condition	With Diagnosed Eye/Vision Condition
Total Emergency Visits	0.15 (0.14–0.16)	0.25 (0.23–0.26)
Eye/Vision-Related	0	0.08 (0.06–0.09)
Non-Eye/Vision-Related	0.15 (0.14–0.16)	0.19 (0.18–0.20)
Total Hospitalizations	0.04 (0.04–0.05)	0.05 (0.05–0.05)
Eye/Vision-Related	0	N/A
Non-Eye/Vision-Related	0.04 (0.04–0.06)	0.04 (0.04–0.04)
Total Office-Based Visits	2.45 (2.37–2.53)	4.19 (4.05–4.32)
Eye/Vision-Related	0	1.07 (1.05–1.09)
Non-Eye/Vision-Related	2.46 (2.38–2.54)	3.20 (3.10–3.31)
Total Outpatient Visits	0.12 (0.12–0.13)	0.20 (0.19–0.21)
Eye/Vision-Related	0	N/A
Non-Eye/Vision-Related	0.12 (0.12–0.13)	0.16 (0.16–0.17)
Total Prescriptions	1.99 (1.88–2.10)	3.43 (3.25–3.63)
Eye/Vision-Related	0	0.29 (0.28–0.30)
Non-Eye/Vision-Related	1.99 (1.89–2.11)	3.12 (2.95–3.29)

Notes: All estimates and confidence intervals (CI) are corrected for the complex survey design of the MEPS and for multiple imputation of missing data. Regression adjusted utilization levels were estimated using a generalized linear model (GLM) with a log link and a gamma error distribution. Source of data: Medical Expenditure Panel Survey (MEPS). N/A=There were too few inpatient or outpatient events to estimate.

Table 4

Regression Adjusted Average Annual Expenditures by Types of Service and Events for Children < 18 Years Old in the United States, 1996–2001

Types of Services	Regression Adjusted Expenditure (\$) (95% CI)	
	Without Diagnosed Eye/Vision Condition	With Diagnosed Eye/Vision Condition
Total Health Care Expenditures	852 (821–883)	1,335 (1,283–1,386)
Total Glass/Contact Lens Expenditures	12 (11–13)	63 (60–66)
Total Emergency Expenditures	57 (55–59)	80 (77–83)
Eye/Vision-Related	0	19 (17–21)
Non-Eye/Vision-Related	57 (55–59)	66 (63–68)
Total Inpatient Expenditures	263 (250–276)	558 (508–607)
Eye/Vision-Related	0	N/A
Non-Eye/Vision-Related	263 (250–276)	535 (486–583)
Total Office-Based Expenditures	179 (172–185)	287 (277–298)
Eye/Vision-Related	0	74 (72–76)
Non-Eye/Vision-Related	179 (173–186)	217 (209–225)
Total Outpatient Expenditures	57 (55–60)	108 (101–115)
Eye/Vision-Related	0	N/A
Non-Eye/Vision-Related	58 (55–60)	73 (68–78)
Total Prescriptions Expenditures	78 (73–83)	133 (124–142)
Eye/Vision-Related	0	7 (6–7)
Non-Eye/Vision-Related	78 (73–84)	124 (115–132)

Notes: All estimates and confidence intervals (CI) are corrected for the complex survey design of the MEPS and for multiple imputation of missing data. Regression adjusted expenditure levels were estimated using a generalized linear model with a log link and a gamma error distribution. Source of data: Medical Expenditure Panel Survey (MEPS). N/A=There were too few inpatient and outpatient events to estimate.

Table 5

Regression Adjusted Average Annual Expenditure by Source of Payments and Ratio to Total Expenditures, for Children < 18 Years Old in the United States, 1996–2001

Type of Service	Regression Adjusted Mean Expenditure (\$) (95% CI)		Ratio to Total Expenditures	
	Without Diagnosed Eye/Vision Condition	With Diagnosed Eye/Vision Condition	Without Diagnosed Eye/Vision Condition	With Diagnosed Eye/Vision Condition
Total Health Care:				
Out of pocket	178 (168–188)	235 (221–248)	0.21	0.17
Third party	676 (653–700)	1,130 (1,089–1,171)	0.79	0.83
Total Glasses/Contact Lens:				
Out of pocket	9 (8–10)	54 (49–59)	0.69	0.72
Third party	4 (4–5)	21 (20–23)	0.31	0.28
Total Emergency Expenditures:				
Out of pocket	8 (8–9)	32 (29–35)	0.14	0.31
Third party	49 (47–51)	70 (67–74)	0.86	0.69
Total Inpatient Expenditures:				
Out of pocket	10 (9–12)	45 (30–60)	0.04	0.07
Third party	253 (240–267)	564 (509–619)	0.96	0.93
Total Office-based Expenditures:				
Out of pocket	39 (37–41)	134 (125–142)	0.22	0.35
Third party	141 (135–145)	252 (243–261)	0.78	0.65
Total Outpatient Expenditures:				
Out of pocket	4 (4–4)	48 (44–52)	0.07	0.32
Third party	53 (51–56)	104 (97–110)	0.93	0.68
Total Prescriptions Expenditures:				
Out of pocket	27 (25–29)	53 (50–57)	0.34	0.35
Third party	52 (48–56)	99 (92–106)	0.66	0.65

Notes: All estimates and confidence intervals (CI) are corrected for the complex survey design of the MEPS and for multiple imputation of missing data. Regression adjusted expenditure levels were estimated using a generalized linear model with a log link and a gamma error distribution. Ratios were computed using regression adjusted expenditure estimates. Source of data: Medical Expenditure Panel Survey (MEPS).

Table 6

Ratio of Regression Adjusted Expenditures by Race and Family Income for Children < 18 Years Old in the United States, 1996–2001

Type of Services	Ratio of Black to White Regression Adjusted Mean Expenditures		Ratio of <400% FPL to 400+% FPL Regression Adjusted Mean Expenditures	
	Without Diagnosed Eye/Vision Condition	With Diagnosed Eye/Vision Condition	Without Diagnosed Eye/Vision Condition	With Diagnosed Eye/Vision Condition
Total Health Care Expenditures	0.62	0.62	0.82	0.82
Total Corrective Lens Expenditures	1.00	1.00	0.92	0.90
Total Emergency Expenditures	0.79	0.78	0.82	0.82
Eye/Vision Related	N/A	2.11	N/A	2.00
Non-Eye/Vision-Related	0.77	0.78	0.84	0.82
Total Inpatient Expenditures	0.96	0.96	1.49	1.49
Eye/Vision Related	N/A	N/A	N/A	N/A
Non-Eye/Vision-Related	0.96	0.96	1.49	1.49
Total Office-Based Expenditures	0.52	0.52	0.82	0.83
Eye/Vision Related	N/A	0.96	N/A	1.07
Non-Eye/Vision-Related	0.52	0.51	0.82	0.82
Total Outpatient Expenditures	0.57	0.57	0.45	0.83
Eye/Vision Related	N/A	N/A	N/A	N/A
Non-Eye/Vision-Related	0.55	0.55	0.82	0.82
Total Prescriptions Expenditures	0.44	0.43	0.70	0.70
Eye/Vision Related	N/A	1.50	N/A	0.75
Non-Eye/Vision-Related	0.43	0.43	0.69	0.70

Notes: Notes: All estimates and confidence intervals (CI) are corrected for the complex survey design of the MEPS and for multiple imputation of missing data. Regression adjusted expenditure levels were estimated using a generalized linear model with a log link and a gamma error distribution. Ratios were computed using regression adjusted expenditure estimates. Source of data: Medical Expenditure Panel Survey (MEPS). N/A=There were too few inpatient and outpatient events to estimate or expenditure levels were zero.