Trends in Annual Medicare Expenditures for Glaucoma Surgical Procedures From 1997 to 2006

Jordana K. Schmier, MA; David W. Covert, MBA; Edmund C. Lau, MS; Alan L. Robin, MD

Objective: To identify payments and changes in payments for glaucoma surgical procedures among Medicare beneficiaries in the United States and to evaluate trends in costs based on the types of procedures being performed.

Design: Retrospective analysis using 1997 through 2006 Part B Medicare Beneficiary Encrypted Files. The annual number of claims and payments for glaucoma surgical procedures were calculated, as were the rates per 100,000 beneficiaries.

Results: Overall, there were decreases in both the number of glaucoma surgical procedures and the amount of annual payments from 1997 to 2001 but an increase in the number of procedures in the following years. Trends in claims and payments vary according to procedure. Average payments for trabeculectomies decreased over time, while annual payments for cyclophotocoagulation and shunt-related procedures have increased. After an initial decline, there was a substantial increase in the number of trabeculoplasties in conjunction with advancements in technology and a change in the global period for reimbursement. Patterns of surgery rates were similar to volume of surgical procedures.

Conclusions: Findings suggest that while the overall number of glaucoma surgical procedures is increasing, payments have been decreasing. Clinical and technological advancements and reimbursement decisions may influence surgeons’ preferences and, therefore, costs to Medicare.

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Glaucoma is one of the leading causes of global blindness. More than 2 million people in the United States have primary open-angle glaucoma and that number is expected to exceed 3 million by 2020. Prevalence increases with age, with nearly 9% of white individuals and 23% of black individuals diagnosed with glaucoma by the age of 75 years. As the population ages, it is likely to be an increasing burden on health care providers and payers. In the United States, projections of increasing prevalence and duration of disease suggest somber news on the likely increase in blindness due to glaucoma as the population ages. The Austrian Salzburg-Moorfields Collaborative Glaucoma Study evaluated the likely prevalence of primary open-angle glaucoma and related conditions and cautioned that the medical community is ill prepared to handle the growing number of patients over the coming decades. A UK study raises similar concerns.

Initial treatment for open-angle glaucoma is often the reduction of intraocular pressure (IOP) with pharmacologic therapy. Even when patients successfully adhere to their therapy regimen, pharmacologic treatment may be inadequate to lower IOP; therefore, surgical options are used. The most common surgical treatments for inadequately controlled IOP in open-angle glaucoma include laser trabeculoplasty, filtering surgery, shunt surgery, and cyclodestructive procedures.

Management and treatment of glaucoma can be costly, and it has been estimated that glaucoma is the primary reason for ophthalmologist visits in the United States. Rein and colleagues estimated that the annual direct medical costs of glaucoma, including not only surgical procedures, but also routine outpatient and inpatient care and estimated prescription and over-the-counter medications, in the United States among adults 40 years and older was $2.86 billion (in 2004 dollars) and that medical therapy accounts for 38% to 52% of direct costs. Nonmedical direct costs (eg, assistive devices or guide dogs) and indirect costs (eg, lost productivity or unpaid caregiver assistance) were estimated to be higher than direct medical costs across all ophthalmic conditions.
The data file (1997-2006 5% Medicare Beneficiary Encrypted Files [BEF]) consisted of Medicare claims from a 5% systematic sample of beneficiaries not enrolled in a health maintenance organization (HMO). Among eligible US citizens and permanent residents 65 years and older, Medicare coverage is common; thus, the 5% BEF sample can be treated as a population-based representative sample of elderly individuals. This sample is developed by the Centers for Medicare and Medicaid Services using the same sampling criteria each year. Thus, the same patients are included in the BEF data each year (unless they die) as well as new patients who met the sampling criteria entering each year; therefore, longitudinal treatment patterns can be evaluated. To ensure that the data were representative of typical elderly Medicare beneficiaries, patients who were included in the Medicare data prior to age 65 years (for reasons such as renal failure or other disabilities) were excluded from the analysis.

The BEF data include 7 claims components: inpatient, outpatient (ambulatory and outpatient care provided in a hospital facility), durable medical equipment, hospice, home health agency, skilled nursing facility, and carrier claims. After an initial evaluation of glaucoma claims in all the data sets, we used only the carrier data. Physician data reflect claims for service provided by physicians regardless of the location (eg, hospital, outpatient clinic, office) and capture nearly all incidents (>98%), based on our review of the data, which found that only 1.3% of claims for glaucoma procedures during the observation period were from emergency departments, inpatient hospitalization, and nonoutpatient locations) of glaucoma surgical care each year. In addition, claims for physician services are consistently filed using Current Procedural Terminology (CPT) codes. This facilitates the analysis and minimizes potential errors introduced by coordinating across different coding systems (eg, International Classification of Diseases, Ninth Revision, Clinical Modification procedure codes). The BEF data were treated with appropriate integrity, security, and confidentiality, as detailed in the Data Use Agreement required by Centers for Medicare and Medicaid Services.

This study identified Medicare payments associated with glaucoma surgical procedures in each year for which data were available. Payments (amounts paid by Medicare) for glaucoma surgical procedures (CPT codes 65800-66770) were calculated. Payments for secondary procedures were not included. Payment amounts from different years were inflated to January 1, 2008, US dollars using the Bureau of Labor Statistics Consumer Price Index for medical care commodities. Data analysis was performed using SAS v9.1 (SAS, Cary, North Carolina).

Table 1 presents the number of surgical procedures reimbursed in each year from 1997 to 2006 inclusive. Overall, there was a decrease in the total number of glaucoma surgical procedures from 1997 to 2001 and an increase in the following years. The number of laser trabecuoplasties (CPT code 65855) decreased each year from 1997 to 2001. In 2002, the number increased to greater than 1997 levels and then increased each year through 2006. Total trabeculectomies (with or without previous surgery or trauma, CPT codes 66170 and 66172) increased each year through 2006. The combined number of placement and revision of glaucoma drainage devices (CPT codes 66180 and 66185, respectively) increased annually, with a sharp jump in 2002 and 2003 and then a leveling off in subsequent years. There was a substantial increase in cyclophotocoagulation pro-

Table 1. Annual Number of Glaucoma Procedures Reimbursed by Medicare, 1997 to 2006

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<td>1740</td>
<td>1700</td>
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<td>200</td>
<td>460</td>
<td>260</td>
<td>220</td>
<td>380</td>
<td>220</td>
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<td>240</td>
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<td>6560</td>
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In 2005 and 2006, this included 66710 and 66711.

An important driver of glaucoma treatment costs is surgery. A recent study estimated the number of glaucoma surgical procedures covered by Medicare from 1995 to 2004 and identified a paradigm shift away from primary trabeculectomy procedures, although it did not examine Medicare payments per se. The objectives of the present study are to identify the payments and changes in payments for common glaucoma surgical procedures among older adults in the United States over a 10-year period and to evaluate trends in payments in light of shifts in the procedures being performed.
The surgical procedures for which payments decreased more than the average were not performed more often. Similarly, procedures for which payments decreased more than the average were not performed less frequently. The Table 2 presents the change in volume and change in average payment for each procedure. For example, the average payments for trabeculectomy without previous surgery went down by 35%, yet trabeculectomies decreased by 55% during the study period. In contrast, the average payment for cyclophotocoagulation went down by 44%, but the number of claims more than quadrupled. Average payments decreased by 46% for trabeculectomy, but procedures increased over time. This pattern was evident across other surgical procedures also, suggesting little association between average payments per claim and the decision to perform specific procedures.

Table 2. Annual Rate (Per 100 000 Beneficiaries) of Glaucoma Procedures Reimbursed by Medicare, 1997 to 2006

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<td>Laser trabeculectomy</td>
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<td>461.53</td>
<td>492.98</td>
<td>547.45</td>
<td>563.83</td>
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<td>Trabeculectomy, no previous surgery</td>
<td>193.28</td>
<td>190.83</td>
<td>170.59</td>
<td>150.67</td>
<td>155.31</td>
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<td>66172</td>
<td>Trabeculectomy, previous surgery or trauma</td>
<td>45.82</td>
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<td>50.04</td>
<td>49.33</td>
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<td>Aqueous shunt to reservoir</td>
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<td>Iridectomy, sector, for glaucoma</td>
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<td>10.16</td>
<td>8.71</td>
<td>358.08</td>
<td>461.53</td>
<td>492.98</td>
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Abbreviation: See Table 1.

A recent study by Ramulu and colleagues found trends in use of glaucoma surgical procedures during a comparable period. This prior study found that the number of trabeculectomies performed in the Medicare population was decreasing, while the number of alternative procedures, such as laser trabeculectomies, placement and revision of glaucoma drainage devices, and cyclophotocoagulation procedures, increased over time. The current study evaluates the consequence of this paradigm shift in surgical glaucoma procedures on Medicare payments. Like the previous study, we found that the total number of glaucoma surgical procedures is increasing. However, in the present study, we used individual claims data that allowed us not only to examine trends in glaucoma surgical procedures but also to consider trends in expenditures for these procedures. We found that total payments for surgical procedures have been decreasing, in part as a result of a shift to lower-cost procedures.
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ultimately affect the frequency of various procedures. Previous research on the effect of changes in reimbursement suggests that they may lead to small variations in volume or type of procedures or surgeries, with an increase in cataract extractions possibly replacing lost profits from lower reimbursement for other procedures. This pattern of substitution may be more of an issue for procedures that are elective; for example, there was a greater effect on the number of cataract extractions than on other procedures when reimbursement was changed from fee-for-service to capitation in a study of US ophthalmologists. The present study found no evidence of this having taken place. We found that procedures whose payments decreased substantially more than the average were performed more often while those whose payments decreased less than the average were performed less often during the study period. A great deal of research has been conducted on how changes in reimbursement affect volume and practice patterns. However, there is no clear consensus on the extent to which reimbursement influences practice patterns, and it may differ by therapeutic area. For example, Ellwein and

Table 3. Annual Medicare Payments and Average Payment for Glaucoma Procedures, 1997 to 2006 (Inflated to 2008 US Dollars)

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<th>CPT Code</th>
<th>Procedure</th>
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Abbreviation: See Table 1.

a In 2005 and 2006, this included 66710 and 66711.

Figure. Change in procedure volume and average payment per claim, 1997 to 2006. Current Procedural Terminology codes: 65855 = laser trabeculoplasty; 66170 = trabeculectomy, no previous surgery; 66172 = trabeculectomy, previous surgery or trauma; 66180 = aqueous shunt to reservoir; 66185 = revision of aqueous shunt; 66625 = iridectomy, peripheral, for glaucoma; 66630 = iridectomy, sector, for glaucoma; 66710 = cyclophotocoagulation (in 2005-2006, this included 66711); 66761 = laser iridotomy; and 66762 = laser iridoplasty.
Urato\textsuperscript{19} found that average costs per Medicare beneficiary for ophthalmic care decreased by 25% from 1991 to 1998 while overall Part B Medicare costs decreased by only 10%. This was despite an increase in the prevalence and resources associated with care of cataract, glaucoma, age-related macular degeneration, and diabetic retinopathy during the same period. In contrast, our finding that procedure frequency was not associated with reimbursement suggests that financial reward did not affect treatment decisions and that use of newer technologies with better outcomes has increased, despite lower presumed profit margins for providers.

Medicare payments are subject to other types of policy decisions. For example, changes in the length of the global period (the postoperative period during which additional billing is limited) following these procedures may affect resource use. For instance, prior to January 1, 2002, the global period for laser trabecuoplasty was 90 days; from that date forward, it was 10 days. Changes in the global period, essentially reclassifying procedures from major (90-day global period) to minor (10- or 0-day global period), may affect how later office visits are coded. Further, a repeatable procedure may be performed more often when the global period is shortened. Other policy decisions, such as changes in coverage introduced by the Benefits Improvement and Protection Act of 2000, which permitted additional glaucoma screening, could increase the number of patients with glaucoma eligible for treatment and, therefore, affect resource use.

There are other changes that may affect the trends in procedures and payments, in particular, medical advances that can affect practice patterns. Paikal and colleagues\textsuperscript{22} conducted a multivariate analysis of Medicare data and found that reimbursement were not associated with the volume of trabecuoplasties and trabeculectomies performed. They explain their findings by suggesting that clinical developments rather than changes in reimbursement for trabecuoplasty or trabeculectomy appear to be the major drivers for incidence of glaucoma surgery.\textsuperscript{22} Technological advancements, such as the availability of selective laser trabecuoplasty, more useful aqueous shunts to lower IOP,\textsuperscript{21} and broader use of endoscopic cyclophotocoagulation in conjunction with cataract surgery,\textsuperscript{22-24} are likely to have influenced practice patterns, as would the introduction of new graduates who may have more exposure to these new technologies into the field; these may contribute to decreased use of previously common procedures in favor of newer procedures. More accurate screening technologies may also permit identification of glaucoma earlier in the disease process, which could influence the severity of cases and, therefore, the appropriateness of various treatments. The availability of new classes of medications during this period (prostaglandin analogs, \(\alpha\)-agonists, topical carbonic anhydrase inhibitors, and a fixed combination of carbonic anhydrase inhibitor and \(\beta\)-blocker) may have reduced or delayed the need for surgery for many patients. Although Medicare prescription data from this period are not available, Strutton and Walt\textsuperscript{25} speculate that decreases in several types of glaucoma surgeries are associated with improved pharmacologic therapies. More understanding of the difficulties of adherence\textsuperscript{26-28} may have the opposite effect, that is, encouraging physicians to suggest surgical interventions earlier. Furthermore, the release of major study results could influence the mix of procedures performed and, thus, payments.

There are also other factors, such as population demographics (eg, an aging population, variation in race and glaucoma risk) and ophthalmologist volume, that could influence the trends in procedures. Rachmiel and colleagues\textsuperscript{29,30} used the Ontario Health Insurance Plan data to evaluate the number of glaucoma and cataract surgeries, trends in the use of pharmacological agents, and the number of practicing ophthalmologists from 1992 to 2004. They found a trend toward a decrease in trabeculectomies associated with increased prostaglandin prescriptions and a strong and significant association between the trabeculectomy rate and the decrease in the number of ophthalmologists. While it is not possible to control for all these factors in this analysis, it is important to consider the overall context in interpreting these trends.

There are some important limitations to this study, some of which have been described by Coleman and Morgenstern\textsuperscript{11} in their review of Medicare database analyses. First, the Medicare claims file is an administrative database, not a clinical one. Thus, the only patient characteristics that are known are those that can be identified in claims. Clinical markers, such as IOP or other indicators of severity and outcomes of surgery, cannot be reliably determined from these data. Part D (prescription medication) data were not available during the time covered by these data. Second, we only used carrier claims in this analysis. As such, payments to institutions for these same surgeries, ie, facility fees, were not included. Also not included in the payments presented herein are other associated services, such as anesthesiology, laboratory charges, and other evaluation and management services provided by the physician. Further, this estimate does not include any inpatient care or home health, skilled nursing, or durable medical equipment claims, based on the low volume of claims in these services being associated with glaucoma surgery. As with any claims database, there is some likelihood of coding errors, although a review of Medicare claims data for cataract surgery suggested accuracy of 96% and higher.\textsuperscript{32} We assumed that these errors would be random and thus would not bias the results. We did not require that beneficiaries whose records indicated glaucoma surgery demonstrate other evidence of glaucoma.

While glaucoma is uncommon in people younger than 40 years, there are a substantial number of patients with glaucoma aged 40 to 64 years who are covered by private insurance. Though many studies have examined changes associated with Medicare fee reductions, it is unclear how these reductions might affect care overall. For example, practices that treat Medicare patients almost exclusively might react to these changes differently than practices with many privately insured patients. The trends observed herein might also be influenced by practice characteristics. Similarly, we excluded patients who were enrolled in the Medicare Advantage program during their period of enrollment in the HMO, which may affect generalizability. Beneficiaries could have enrolled and disenrolled in each year. Little is known about differences between enrollees in these Medicare HMOs, who compose about 15% of eligible seniors, although there may be differences in demographic characteristics\textsuperscript{33} and in rates of inpatient hospitalization.\textsuperscript{34} Studies that have compared costs across traditional and HMO programs found
that inpatient hospitalization costs may be as high or higher in Medicare HMOs, although the likelihood of hospitalization may be lower. One study evaluated the use of prostaglandin analogs in this population, but little else is known about differences in the costs of glaucoma surgery. The medical costs identified herein are but one element of the overall costs for a patient with glaucoma. There are multiple other types of direct costs, including visual rehabilitation and assistive devices, some of which may differ by disease severity. Increasing visual impairment has been shown to be associated with substantial increases in claims to Medicare. The shift observed herein is limited to direct medical fees paid to physicians, excluding prescriptions, which were not available in Medicare data during the study period. Very few glaucoma studies have included other types of costs, though direct costs may be less than half of total glaucoma expenditures. Regardless, Medicare payments remain an important component of the cost of glaucoma in the United States and the overall trend toward lower-cost surgical procedures (ie, fewer trabeculectomies) despite the increased use of newer technologies (ie, more glaucoma drainage devices) observed in this analysis may have a substantial impact on national glaucoma expenses. Further advances and the application of new technologies may help to moderate the cost of providing glaucoma care to all who require it.

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REFERENCES