Use of Retinal Procedures in Medicare Beneficiaries From 1997 to 2007

Pradeep Y. Ramulu, MD, MHS, PhD; Diana V. Do, MD; Kevin J. Corcoran, COE, CPC, FNAO; Suzanne L. Corcoran, COE; Alan L. Robin, MD

Objective: To observe how the treatment of retinal conditions changed over the preceding decade.

Methods: Medicare fee-for-service data claims filed between 1997 and 2007 were analyzed.

Results: Fewer than 5000 intravitreal injections of a pharmacological agent were performed annually between 1997 and 2001. Thereafter, the annual number of intravitreal injections more than doubled every year through 2006, reaching a high of 812,413 in 2007. Photodynamic therapy procedures decreased 83% from a peak of 133,565 procedures in 2004 to 22,675 procedures in 2007, while laser treatment of choroidal lesions or neovascularization decreased 83% from a peak of 82,089 in 1999 to a minimum of 13,821 in 2007. Vitrectomies for primary retinal detachment (with or without scleral buckling) increased 72% over the study period from 11,212 in 1997 to 19,923 in 2007, while scleral buckles performed without vitrectomy decreased 69% from 8,691 to 2,660. Substantial volume increases were also observed for vitrectomy with retinal membrane stripping (90% increase from 29,426 in 1997 to 56,051 in 2007) or endolaser panretinal photocoagulation (86% increase from 10,319 in 1997 to 19,154 in 2007). Volumes of pneumatic retinopexy, laser prophylaxis for retinal detachment, laser treatment for retinal edema, and laser treatment for retinopathy all changed less than 25% from 1997 and 2007.

Conclusions: Marked changes in the use of several retinal procedures occurred between 1997 and 2007, particularly in the treatment of macular degeneration and retinal detachment. These changes point to greater acceptance and incorporation of vitrectomy and intravitreal injection as treatment modalities.


Retinal disease is highly prevalent among older individuals, and both age-related macular degeneration (AMD) and diabetic retinopathy account for more than half the irreversible blindness in older Americans. The prevalence of both macular degeneration and diabetic retinopathy increases with age, and the number of Americans affected by these conditions is expected to increase substantially as the number of Americans older than 65 years doubles from 2010 to 2040. Additionally, dietary and exercise habits are expected to increase the prevalence of diabetes mellitus within each age group. Thus, many more individuals with retinal diseases are expected to require treatment in future years.

The last decade has seen substantial changes in the treatment options available for many retinal diseases, particularly in the treatment of neovascular AMD (Figure 1). In the 1990s, thermal laser treatment for extrafoveal and juxtafoveal choroidal neovascularization (CNV) represented the only significant treatment option with a demonstrated benefit. In 2000, photodynamic therapy, involving laser activation of intravenously delivered verteporfin, was approved for use after having been demonstrated to be effective for subgroups of individuals with subfoveal CNV due to AMD who met specific angiographic guidelines. In 2006, monthly intravitreal injections of ranibizumab, a monoclonal antibody that inhibits vascular endothelial growth factor (VEGF), demonstrated superior visual acuity outcomes compared with photodynamic therapy in eyes with CNV due to AMD and was approved by the Food and Drug Administration. Off-label use of intravitreal bevacizumab, also...
a monoclonal antibody against VEGF, is also commonly used for the treatment of neovascular AMD.\(^{14,15}\)

Intravitreal injections of steroids and VEGF inhibitory agents have also been described in the treatment of diabetic, pseudophakic, and uveitic macular edema.\(^{16-22}\) Intravitreal VEGF inhibitory agents have also been shown to quickly (though temporarily) resolve retinal or anterior segment neovascularization from diabetes or other conditions producing retinal ischemia.\(^{23,24}\) Additional clinical trials are being conducted with numerous intravitreal pharmacologic agents to determine their efficacy and safety in a variety of retinal vascular diseases.

Pharmacological advances for the treatment of retinal conditions have been complemented by advances in surgical technique. In particular, several advances have been made in vitrectomy, including the development of sutureless, microincisional vitrectomy surgery; better visualization systems; and a greater variety of microincisional instruments and materials.\(^{25}\) These advances may have allowed vitrectomy to obtain a greater role in the treatment of retinal disease.

One method to gauge the acceptance of newly introduced procedures, and to measure to what extent they have displaced the previous standard of care, is to track how frequently these procedures are performed. This report examines the trends in use of the most common retinal laser and surgical treatments for Medicare beneficiaries over the period from 1997 to 2007.

### METHODS

As previously described,\(^{26}\) files generated by the Centers for Medicare and Medicaid Services, previously known as the Health Care Financing Administration, were used to acquire data points for this retrospective analysis. The data gathered are in the public domain and are never more recent than 2 years old. In 2009, the most recent data available were for 2007. Data for individuals enrolled in managed care Medicare plans or Medicare Part C are not publicly available and are not included in this analysis. Similarly, data for non-Medicare beneficiaries are available only through providers of specific health plans and are not included as part of this analysis.

The volumes of paid claims for Part B services corresponding to specific Current Procedural Terminology (CPT) codes were tabulated into separate files for Medicare beneficiaries for each calendar year. Current Procedural Terminology codes ranging from 67015 to 67228 were analyzed as part of this study. These CPT codes correspond with procedures used for retinal and posterior chamber procedures.

Communication with the Johns Hopkins institutional review board determined that the study did not require institutional review board approval. Because human subjects were not directly involved, it was not necessary to obtain Health Insurance Portability and Accountability Act approval nor register the study as a clinical trial.

### RESULTS

The volume of the posterior segment laser treatments and surgeries performed among Medicare beneficiaries between 1997 and 2007 is cataloged by CPT code in the Table. The total number of procedures increased every year except from 1997 to 1998, with a total increase of 192% over the study period. The largest year-to-year gains were observed in 2006 and 2007, where a greater than 20% increase in total volume was observed.

Procedure volumes changed most markedly for treatments directed toward neovascular AMD. Fewer than 5000 intravitreal injections of a pharmacological agent were performed annually between 1997 and 2001 but then increased 193-fold from 4215 injections in 2001 to 812 413 injections in 2007 (Figure 2).

Photodynamic therapy first became available for the treatment of neovascular AMD in 2001, when 85 411 procedures were performed. Volume increased 56% to a maximum of 133 565 procedures through 2004, but then decreased 83% to a total of 22 675 procedures in 2007 (eFigure 1, http://www.archophthalmol.com). Thermal laser treatment for CNV decreased 83% over the study period, from 56 966 procedures in 1997 to 13 821 procedures in 2007. Volume decreased 56% between 2004 and 2007, corresponding to the period of greatest growth for intravitreal injections of pharmacologic agents.

Little change was observed for treatments primarily used for diabetic retinopathy (eFigure 2). Laser treatments for retinal edema (CPT code 67210) ranged from 123 909 to 186 964 over the studied decade, while laser treatment for proliferative retinopathy (CPT code 67228) fluctuated between 93 200 and 115 789.

The use of vitrectomy in several settings increased over the study period. Large increases were observed for vitrectomy with membrane stripping (90% increase from 29 426 to 56 051), endolaser (126% increase from 1997 to 4527), or endolaser panretinal photoocoagulation (PRP) (86% increase from 10 319 to 19 154). Vitrectomy performed with or without scleral buckling for repair of retinal detachment (CPT code 67108) also increased 78% over the study period from 11 212 to 19 923 procedures, while scleral buckling as a standalone procedure decreased 69% from 8691 to 2660 procedures (Figure 3). Other retinal detachment procedures, including cryotherapy, pneumatic retinopexy, and laser prophylaxis of retinal detachment, were relatively stable, changing less than 25% from 1997 to 2007.

### COMMENT

Observing changes in procedural volume is one method to determine if, and to what extent, new technological
advances are being accepted into clinical practice. Previous studies that examined the use of retinal procedures did not cover the period after the introduction of VEGF inhibitory agents and only focused on subsets of procedures.27,28 In this report, we examined the volume of retinal procedures performed in Medicare recipients between 1997 to 2007. The 192% increase in the total volume of retinal procedures was much larger than the 11% increase in the population older than 65 years predicted by census data for the closest corresponding 10-year period and the 11% increase in overall Medicare enrollment from 1997 to 2007.6,29 Overall, procedure totals were driven higher by large increases in the number of intravitreal injections performed from 2003 to 2007. Most of the observed increase in intravitreal injection of pharmacologic agents likely resulted from the use of intravitreal VEGF inhibitors for neovascular AMD.

<table>
<thead>
<tr>
<th>Table. Volume Comparison Between Years for Retina Surgery Codes</th>
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<tr>
<td><strong>Description</strong></td>
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<tr>
<td><strong>Posterior sclerotomy</strong></td>
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<td><strong>Vitreous placement</strong></td>
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<td><strong>Vitreous substitute</strong></td>
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<td><strong>Pharmacological agent (injection)</strong></td>
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<td><strong>Lysis of vitreous strands</strong></td>
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<td><strong>Manual</strong></td>
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<td><strong>Laser</strong></td>
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<td><strong>PPV</strong></td>
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<tr>
<td><strong>With retinal membrane stripping</strong></td>
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<td><strong>With laser PRP</strong></td>
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<td><strong>With endolaser PRP</strong></td>
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<td><strong>Removal/release of:</strong></td>
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<td><strong>Encircling element</strong></td>
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<td><strong>Posterior segment implant, extraocular</strong></td>
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<td><strong>Posterior segment implant, intraretinal</strong></td>
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<tr>
<td><strong>Prophylaxis for retinal detachment</strong></td>
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<tr>
<td><strong>Laser</strong></td>
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<tr>
<td><strong>Treatment of retinal lesion or edema</strong></td>
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<td><strong>Laser</strong></td>
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<td><strong>Radiation</strong></td>
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<td><strong>Treatment of choroidal lesion or neovascularization</strong></td>
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<td><strong>Laser</strong></td>
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<td><strong>Photodynamic therapy</strong></td>
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<td><strong>Treatment of retinopathy</strong></td>
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<td><strong>Laser</strong></td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>Change from previous year,</strong>%</td>
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Abbreviations: CPT, Current Procedural Terminology; NA, not applicable; PPV, pars plana vitrectomy; PRP, panretinal photocoagulation.
earlier in eyes with vitreous hemorrhage, though other possible that this trend may reflect a tendency to intervene and/or intravitreal steroids over established laser-based demonstrated superiority of VEGF inhibitory agents observed between 2002 and 2007. No studies have may have contributed to the growth in intraocular in-

notable trend was that vitrectomies with endolaser PRP underlymg the latter half of the studied decade may represent small decrease in PRP and laser for macular edema dur-

Figure 3. Retinal detachment procedures, Medicare recipients, 1997 to 2007.

These injections now represent a major component of the treatment of retinal disease.

Our data derived from CPT codes used in billing services for Medicare recipients do not identify which pharmacologic agent was injected. Thus, we could not assess the relative use of bevacizumab and ranibizumab. It is also possible that some of the growth of intravitreal injections is attributable to other pharmacologic agents, particularly in the period prior to 2004 when injections were less than 2.5% of retinal procedures. For instance, intravitreal steroid injections have been described for use in uveitic, pseudophakic, diabetic, and central retinal vein occlusion–associated macular edema and in combination with photodynamic therapy for treatment of neo-
vascular AMD.17,18,22,30,31 Additionally, pegaptanib was in-

duced for treatment of neovascular AMD in 200432 and may have contributed to the growth in intraocular in-

jections prior to ranibizumab approval.

Less fluctuation was observed with common laser treatments of diabetic retinopathy, ie, laser for macular edema and PRP, though small decreases in use were observed between 2002 and 2007. No studies have demonstrated superiority of VEGF inhibitory agents and/or intravitreal steroids over established laser-based therapies for the treatment of diabetic macular edema or proliferative diabetic retinopathy.16,18,24 As such, the small decrease in PRP and laser for macular edema during the latter half of the studied decade may represent variations due to demographic or health care use trends and not necessarily a shift to alternative therapies (ie, intravitreal injections).

Our data provide limited insights into the treatment of surgical complications of PDR, including vitreous hemorrhage, traction retinal detachment, rhegmatogenous retinal detachment, or combined tractional/re-

gmatogenous retinal detachment. While the database does not allow us to firmly distinguish the type nor underlying etiology of the retinal detachment, one notable trend was that vitrectomies with endolaser PRP (CPT code 67040) doubled from 1997 to 2007. It is possible that this trend may reflect a tendency to intervene earlier in eyes with vitreous hemorrhage, though other reasons for increasing endolaser PRP with vitrectomy cannot be excluded.

Our data demonstrated that, over the study decade, the use of scleral buckling alone to treat retinal detachment decreased, while the use of vitrectomy increased substantially. However, vitrectomy performed alone or in combination with scleral buckling for retinal detachment repair is coded similarly in this database. Thus, we cannot differentiate whether scleral buckling is being re-
placed by vitrectomy alone or by procedures combining vitrectomy with scleral buckling. Vitrectomy (with or without scleral buckling surgery) for pseudophakic reti-

nal detachments has been suggested to produce better anatomic success and visual outcomes compared with scleral buckling alone.33 However, no difference in outcomes has been suggested in the treatment of phakic retinal detachments.34,35 It is possible that advances in vi-

trectomy technique and instrumentation, perceptions that better results were achieved with vitrectomy, and/or a rise in fellowship-trained retinal specialists resulted in greater use of vitrectomy as the preferred method of repairing retinal detachment. In addition, given the older ages associated with our Medicare study population, it is likely that a significant proportion had pseudophakia, which may have influenced the decision to choose vitrectomy over scleral buckling as the surgical procedure.

Vitrectomy use was also noted to increase in several other settings, including with non-PRP endolaser and with membrane stripping. The broader use of vitrec-
tomy across numerous conditions suggests that alternate explanations for its increased use, ie, changing disease prevalence or demographic shifts, are unlikely. It is possible, however, that the frequency of vitrectomy for specific conditions such as epiretinal membranes, vitreomacular traction, or macular holes may have increased with improved retinal imaging, such as optical coherence tomography, which may help better visualize the pathology involved and can yield better insight into when surgical intervention would be appropriate for a specific patient.

Several limitations are inherent in our analysis. Be-

because the database only evaluates paid Medicare claims, this analysis excludes patients younger than 65 years, as well as those older than 65 years receiving their health care outside of Medicare. The exclusion of younger pa-

ients may miss trends due to trauma, type 1 diabetes, or other common conditions rarely found in those older than 65 years. We also cannot necessarily generalize our findings to people older than 65 years receiving their health from insurers outside of Medicare and also Medicare Part C and Medicare health maintenance organizations. Retinal procedures paid for by Medicare may have changed partially as a result of Medicare enrollment or switching between Medicare Parts B and C. Trends might also be created by changes in reimbursement that altered how surgeons coded for their services. We also assume in our analysis that physicians coded procedures correctly, though it is possible that systematic errors are made in coding that would lead to biased conclusions. Finally, there is ambiguity inherent in the CPT coding system, because the underlying diagnosis for which the procedure is performed is not available in the Centers
for Medicare and Medicaid Services data set. For example, vitrectomy for retinal detachment performed with or without scleral buckling is assigned the same CPT code.

The dramatic rise in retinal procedures poses important financial issues to both the ophthalmic community and society as a whole. The increased cost associated with procedure volumes alone may not be significant, because most of the increase results from an intravitreal injection of a pharmacologic agent, a relatively low-cost procedure. However, each injection is also associated with a separate medication charge (not covered in our Medicare database), which is approximately $2000 for each vial of ranibizumab. Medication costs associated with monthly administration of ranibizumab over a 1-year period are approximately $24,000 per patient. Although the costs associated with ranibizumab are high, ranibizumab is the first therapy to significantly improve vision in more than 30% of treated patients, and it has been shown to have a positive impact on vision-related quality of life.36,37 Further work will be necessary to investigate whether lower-cost alternatives, such as bevacizumab, are non-inferior to ranibizumab. Indeed, the Comparison of AMD Treatment Trials (CATT) Study is currently conducting a randomized clinical trial comparing bevacizumab and ranibizumab in eyes with neovascular AMD.

Observing use patterns adds value, because it demonstrates how disease is treated and can be used to identify possible discrepancies between the best evidence-based treatments for a condition (as defined by clinical trials and meta-analyses from the literature) and current practice patterns. In this report, we observe that intravitreal injections of pharmacologic agents have gained widespread acceptance for the treatment of neovascular AMD and that vitrectomy is being increasingly applied to a wide range of retinal conditions.

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Correspondence: Pradeep Y. Ramulu, MD, MHS, PhD, 600 N Wolfe St, Maumenee B-110, Baltimore, MD 21287 (pramulu1@jhmi.edu).

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REFERENCES


Congratulations to the winner of our May quiz, Armin R. Afshar, MD, PGY2 Resident, Section of Ophthalmology and Visual Science, Department of Surgery, University of Chicago, Chicago, Illinois. The correct answer to our May challenge was Latisse-induced periocular skin hyperpigmentation. For a complete discussion of this case, see the Small Case Series section in the June Archives (Priluck JC, Fu S. Latisse-induced periocular skin hyperpigmentation. Arch Ophthalmol. 2010;128[6]:792-793).

Be sure to visit the Archives of Ophthalmology Web site (http://www.archophthalmol.com) and try your hand at our Clinical Challenge Interactive Quiz. We invite visitors to make a diagnosis based on selected information from a case report or other feature scheduled to be published in the following month’s print edition of the Archives. The first visitor to e-mail our Web editors with the correct answer will be recognized in the print journal and on our Web site and will also be able to choose one of the following books published by AMA Press: Clinical Eye Atlas, Clinical Retina, or Users’ Guides to the Medical Literature.