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Measuring the Impact of Cataract Surgery on Generic and Vision-Specific Quality of Life

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Abstract

Purpose—Cataracts are the leading cause of blindness worldwide and cause visual impairment for millions of adults in the US. We compared the sensitivity of a vision-specific health-related quality of life (HRQOL) measure to that of multiple generic measures of HRQOL before and at two points after cataract surgery.

Methods—Participants completed 1 vision-specific and 5 generic quality of life measures before cataract surgery, and again 1-month, and 6-months after surgery. Random effects modeling was used to measure changes over the three assessment points.

Results—The NEI-VFQ25 total score and all 11 subscales showed significant improvements during the first interval (baseline and 1-month). During the second interval (1-month to 6-months post-surgery), significant improvements were observed on the total score and 5 of 11 NEI-VFQ25 subscales. There were significant increases in HRQOL during the first interval on some preference-based generic HRQOL measures, though changes during the second interval were mostly non-significant. None of the SF-36v2TM or SF6D scales changed significantly between any of the assessment periods.

Conclusions—The NEI-VFQ25 was sensitive to changes in vision-specific domains of QOL. Some preference-based generic HRQOL measures were also sensitive to change and showed convergence with the NEI-VFQ25, but the effects were small. The SF-36v2TM and SF-6D did not change in a similar manner, possibly reflecting a lack of vision-related content. Studies seeking to document both the vision-specific and generic HRQOL improvements of cataract surgery should consider these results when selecting measures.

Cataracts are recognized as a leading cause of blindness in the United States and the world. [1,2] Using population-based studies and census data from the year 2000, researchers estimated that 937,000 Americans over the age of 40 were considered blind and that 50% of an additional 2.4 million low-vision cases were cataract-related.[1] The percentage of adults afflicted with cataracts doubles with every decade after age 40, and nearly everyone is affected by the age of 90.[3] Due to the aging US population, the prevalence of cataracts is projected to increase to 30 million by the year 2020.[1,4] Cataract extraction with lens replacement, which is often performed in an outpatient setting, is the most frequently

performed elective surgical procedure among adults over 65 in this country.[5]
Approximately 2 million cataract surgeries are performed annually in the United States.[6]

Visual impairment impacts health-related to quality of life (HRQOL), and has been associated with difficulty performing activities of daily living, decreased independence and life satisfaction, decline in physical and mental functioning, and increased risk of depression.[7–13] Improvement in visual function is expected to promote improvement in other important life domains, suggesting that other age-related declines can be attenuated by enhanced visual function.[14] Cataract extraction, now closely tied with intraocular lens implantation, can improve visual function and quality of life for patients with this condition. [15,16,8,17,18,14,19] Additionally, some have argued that cataract surgery has the potential to produce a greater change in vision than any other ophthalmic condition because of its positive surgical outcomes and the high volume of procedures performed.[20]

With a growing appreciation of measurable patient reported outcomes such as functioning, satisfaction, and quality of life, came the realization that clinical effectiveness (i.e., visual acuity) is not the only outcome that reflects the benefits of cataract surgery.[6,18,21] Studies have demonstrated that tasks associated with visual function and quality of life are stronger predictors of satisfaction with vision and improvement in visual function after surgery than visual acuity.[8,22,14,23–25] Furthermore, improved quality of life has been demonstrated even in those with poor post-surgical visual acuity following surgery, indicating that the benefits of surgery may be underestimated when assessing visual acuity alone.[26,27]

In addition to impacting quality of life, cataract surgery outcomes have important implications for cost-effectiveness and may influence health policy decision-making. While cataract-related cases comprised approximately 60% of eye-care costs for Medicare beneficiaries between 1991 and 1998 and the incidence of cataract increased during that time, Medicare decreased its allowed charges for eye-care in that period.[28] Patients with vision loss have been shown to have increased morbidity and mortality, along with increased Medicare costs, compared to those with normal vision.[29–32] Furthermore, with the number of people over age 65 projected to double from 2000 to 2035, the implications for Medicare and other systems will grow.[33] Thus, it is important to consider measurement strategies that facilitate the measurement of all outcomes impacted by cataract surgery.

For years, ophthalmologists as well as the American Academy of Ophthalmology (AAO) and the Agency for Healthcare Research and Quality (AHRQ) have supported the use of vision-specific and generic quality of life measures in the evaluation of visual impairment. [8,26,34–38] Much literature has been devoted to comparing specific and generic quality of life instruments in the exploration of problems related to vision. Vision-specific instruments such as the 7 and 14 item visual function tests (VF-7[21], VF-14,[38]) and the National Eye Institute Visual Functioning Questionnaires (NEI-VFQ[39,35]) have shown moderate to high correlations with visual acuity and size of visual field defect, but general measures such as the Medical Outcome Study 36 and 20 item Short Forms (SF-36v2™ and SF-20) have not proven sensitive enough to detect vision-related changes.[40–42,14,43] Similarly, SF-36v2™ physical and mental health component scores have not shown improvement following cataract surgery, while vision specific instruments have.[44]

Disease-specific instruments are useful tools that provide information on specific domains relating to the disease of interest. General quality of life measures, however, are important if one wishes to make comparisons across health states for policy decisions. While general measures are often assumed to overlook some function-specific gains, disease-specific measures will underreport health effects in areas not assessed. As an increasing number of Americans reach age 65, it is important to fully inform health policy with research showing

the total impact of vision-related changes. Preference-based measures of HRQOL have the added benefit of facilitating cost-effectiveness analysis.

The current study is part of the Health Measurement in Patients; Tracking Clinical Outcomes study. That overall study's main purpose was to evaluate the sensitivity of various health-related quality of life measures to clinical outcomes among patients in two clinical populations: cataract surgery, and heart failure.[45] This study seeks to compare the sensitivity of the National Eye Institute 25 item Visual Functioning Questionnaire NEI-VFQ25, a vision-specific quality of life instrument, to that of multiple generic HRQOL measures. Findings may help those choosing which generic HRQOL measures to use in addition to the NEI-VFQ25 when measuring the impact of cataract surgery on health-related quality of life and/or conducting cost-effectiveness analyses.

Methods

Participants

Participants were recruited from eye clinics at four sites: The University of California, Los Angeles; the University of California, San Diego; the University of Wisconsin; and the University of Southern California. Recruitment took place during a pre-surgery appraisal visit for cataract lens-replacement surgery.

Clinic staff reviewed the medical records of scheduled patients to assess their eligibility. Participants were required to be at least 35 years old, able to give competent consent, able to hear and understand verbal instructions in English, and have sufficient vision and ability in reading and writing English to complete the questionnaires. Patients who were undergoing simultaneous glaucoma, corneal or vitreoretinal procedures were excluded. Patients with traumatic cataract and with visual impairment so severe they were unlikely to be able to read the self-administered questionnaires were also excluded. However, upon enrollment, patients were allowed to have assistance from another person while completing the questionnaires.

At enrollment, participants were given the assessment packet to take home. They were asked to complete it and return it by mail (within 7 days) to the project's data collection center at the UC San Diego - Health Services Research Center (HSRC). For the 1-month and 6-month follow-ups, HSRC mailed out the appropriate version of each instrument to each study participant who returned the baseline measurement packet in a postage-paid self-addressed return envelope. Follow-up reminders in the form of post cards were mailed to participants at two week intervals in the event the measurement packet was not received by the data collection center.

Measures

Questionnaires were administered at three time points: prior to undergoing cataract surgery, 1-month after surgery, and 6-months after surgery. The questionnaire was comprised of a general demographic section, followed by the series of HRQOL measures described below.

NEI -VFQ25—The National Eye Institute 25-Item Visual Functioning Questionnaire (NEI-VFQ25) is a multi-dimensional self-report measure of vision-related health status.[39,35] Scoring yields a total visual functioning score, 11 visual functioning subscales, and a single-item general health question.

EQ5D—The EQ5D was originally developed by the EuroQol collaborative group from Western Europe.[46] It contains 5 dimensions mobility, self-care, usual activity, pain/

discomfort, and anxiety/depression. Participants are asked to rate each dimension on a 3-level scale of “no problem,” “some problem,” or “extreme problem.” The combination of dimensions and the 3-level rating scales results in 243 possible combinations (states). Scoring is accomplished using a set of ‘weights’ applied for each specific state. Values for the scoring weighting system were derived from a community sample who valued each health state using the time-tradeoff valuation technique for both the United Kingdom,[46] and the U.S.[47] Information on the EQ5D is available at: <http://www.euroqol.org>.

Health Utilities Index (HUI)—The Health Utilities Index (HUI) is a preference-based health state classification system.[48] The system includes multiple question sets and scoring systems. The current standard questionnaire can be used to derive both of the indices examined in this study; the Health Utilities Index Mark 2 (HUI2) and Mark 3 (HUI3). The HUI2 consists of six dimensions of health status: sensation (vision, hearing, speech), mobility, emotion, cognition, self-care, pain, and fertility (not assessed in the current study). [49] The HUI3 scoring system yields eight dimensions of health status: vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain and discomfort.[50] There are multiple levels per attribute for both systems, ranging from three to five for the HUI2, to five or six levels per attribute for the HUI3. The 15-question self-administered questionnaire used in this study includes all necessary questions and attributes to score both HUI2 and HUI3. Both HUI2 and HUI3 scoring can result in health states that range from less than 0 to 1.0. HUI utility scores are based on community preference surveys in Canada. Reference information on HUI is available at: <http://www.healthutilities.com>.

Quality of Well-being Self-Administered Scale (QWB-SA)—The QWB-SA is a self-report measure of symptoms and functioning.[51] It asks participants to report their experience of symptoms/problems and limits to functioning over the previous three days. Function items are classified into three separate domains: mobility, physical activity, and usual activity. The scoring algorithm yields four domain scores (one for symptoms and three for function) that are combined into a “well-being” total score that ranges from zero (dead) to 1.0 (optimum functioning). The QWB-SA scoring algorithm utilizes preference-weights that were obtained from community samples who rated various symptoms and health states. The QWB-SA was derived from the original interviewer administered QWB.[52] The QWB-SA has been shown to be highly correlated with, and to have similar psychometric properties as the interviewer administered QWB.[51] Further details about its development are available at <https://hoap.ucsd.edu/qwb-info/>.

SF-36v2™—One of the most widely used HRQOL measures in the world, the SF-36v2™ consists of 36 questions derived from a larger pool of items in the Medical Outcomes Study. [53,54] The SF-36v2™ used in this study is the most recent version of a series of scoring systems. It includes eight subscale domains (physical functioning, role limitations - physical, bodily pain, general health, vitality, social functioning, role limitations - emotional, mental health) and two summary scales (physical and mental).[55] It can be either self-administered (as used in this study), or administered by a trained interviewer. There is a substantial body of literature supporting its reliability and validity.[56–58]

SF-6D—In order to obtain a preference-based measure from the nonpreference-based SF-36v2™, Brazier et al. used utility rating methods to estimate health state evaluations for 18,000 states that could be derived from a subset of the SF-36v2™ items.[59] This method and index is known as the SF-6D. The SF-6D is computed from a subset of 11 of the 36 questions from the SF-36v2™ questionnaire. [59] The scoring algorithm produces scores ranging from 0.30 to 1.0 for those alive.

Statistical Analysis

The number of participants with data at each assessment period for each outcome measure is provided in Table 1. In order to utilize all to the available data, yet still provide effect sizes and study change over specific intervals, the data was analyzed two ways. First, linear random effects modeling was used to assess the change in outcome measure scores over all 3 time periods as a whole. Time was treated as a continuous scale (0, 1 and 6 months). Both random slope and random intercept were considered and a likelihood ratio test was used to assess the significance of the random effect. These data are presented in Table 2. Next, related-samples t-tests were used to assess the statistical significance and effect size of change between baseline and 1-month, as well as between 1-month and 6-months post-surgery for the types of measures. For these analyses, only participants with complete data for each type of measure at both assessments are included. (Tables 3, 4, and 5) Bonferroni adjustments were used to correct alpha for the 10 SF-36v2TM comparisons (0.005), and the 13 NEI-VFQ25 comparisons (0.0038).

Results

For the cataract portion of the larger study, 458 participants were consented and enrolled. Of those, 378 (82.5%) returned the baseline study packet and were sent the 1-month follow-up packet. Of those, 318 (85.1%) returned the 1-month packet and were sent the 6-month packet. Of those, 301 (95%) returned the 6-month follow-up packet. Overall, of the 458 consented participants, 235 (51.3%) returned the survey packets from all three time points.

Disease Specific HRQOL

Results generally suggest disease-specific health-related quality of life measures are sensitive to change. With the exception of the single-item general health question, there was a significant overall linear effect of time on all NEI-VFQ25 scales, with scores increasing significantly between baseline and 6-months following cataract surgery (see Table 2 and Figure 1). Data on change across the two specific time intervals shows that all scales except general health increase significantly from baseline to 1-month with effect sizes ranging from small to large (0.19–1.11) over the period when surgery occurred. Changes across the second interval, were considerably smaller, but remained significant for the total score and 5 of the 11 subscales (Table 3).

Generic HRQOL

Nonpreference-based—Using the vision-specific measure and subscales as a gauge, the non-preference-based health-related generic quality of life measure (SF-36v2TM) showed very minimal changes in HRQOL across all time intervals. With random effects modeling and all available data, the only scale nearing significance was physical function subscale which decreased between baseline and 6 months. (Tables 2 and Figure 2). When restricting analyses to only people who completed both assessments at the two different time intervals studied in Table 4, the only sizable changes were a small decrease in social function between baseline and 1-month, and a small increase in role limitations - physical between 1-month and 6-months.

Preference-based—Results were mixed regarding the sensitivity of preference-based generic health-related quality of life measures. There was an overall linear effect of time between baseline and 6-months on the HUI2, the HUI3, and the QWB-SA, such that scores increase significantly following cataract surgery (Table 2 and Figure 3). Results also suggest significant change between baseline and 6-months following surgery on the EQ5D. However, scores on the EQ5D appear to increase slightly at 1-month before decreasing again at the 6-months. The overall linear change in the SF-6D between baseline and 6-

months following surgery was non-significant. With the notable exception of the SF-6D, there were increases between baseline and 1-month for all preference-based measures. However, the decrease in the EQ5D was the only preference-based measure to change between 1-month and 6-months post-surgery, (Table 5 and Figure 3). When the data was examined with t-tests among participants who completed all preference-based measures at each interval, the HUI2 and HUI3 showed significant changes between baseline and 1-month, while the decrease in the EQ5D noted above was also significant.

Discussion

The main objective of this study was to explore the sensitivity of the NEI-VFQ25 and a variety of generic measures of health-related quality of life following cataract surgery. Our results indicate that some of these measures capture expected changes in health-related quality of life experienced by older adults who have undergone cataract surgery. Specifically, the results suggest that with the exception of the General Health question, all subscales on the Visual Functioning Questionnaire showed significant increases in quality of life between baseline assessment and 6 months following cataract surgery. Additionally, there were significant increases in quality of life between baseline assessment and 6 months following cataract surgery when the outcome measure was the Health Utility Index Mark 2 and Mark 3, and the Self Administered Quality of Well Being. However, the size of the increases in these preference-based measures was relatively small, and the mean impact of cataract surgery on generic HRQOL does appear to be large in this study.

Interestingly, small but significant decreases in EQ5D scores were found between the 1-month and 6-month assessments. Finally, changes in scores of the SF-36v2™ and the SF-6D were not statistically significant at any time periods. While it is possible that non-vision quality of life decreases offset vision-related quality of life, this seems unlikely since most of the other generic measures improved overall. This suggests that the SF-36v2™ and SF-6D were less sensitive to changes in quality of life in people who underwent cataract surgery..

As expected, most of the increase in quality of life scores across measures was found between baseline and the 1-month assessment. Here, the immediate impact of restored vision on quality of life from cataract surgery is captured. However, almost all subscales of the NEI-VFQ25, which are expected to be more sensitive since all questions focus on aspects of vision and vision-related functioning, continued to increase in the second post-assessment period. It is during this time that surgery patients are expected to continue to have smaller quality of life improvements as they heal from any procedure, adjust to the changes in vision, and resume activities they once enjoyed.

The generic HRQOL measures are designed to capture all aspects of health and well-being and are thus expected to be less sensitive to changes in one specific aspect of health (vision), at least less sensitive than a vision-specific QOL measure. Yet these measures are important for demonstrating improvements in overall health, allowing comparisons across disease, and facilitating cost-effectiveness analysis. The HUI2, HUI3, and QWB-SA captured the expected increases, with the HUI3 showing a much larger increase of 0.06, compared to 0.03 for the HUI2 and QWB-SA. The drop in the EQ5D was unexpected and may be related to the brevity of this measure, having only 5 questions, while the other measures are longer and more detailed. It is notable that none of the SF-36v2™ domains or summary scales and the SF-6D which is derived from the SF-36v2™ showed significant change at any time point. One explanation for this lack of sensitivity is that the SF-36v2™ has fewer questions about physical symptoms, especially vision-related symptoms, than some of the other measures.

When examining the results using t-tests and only data from participants who completed paired comparisons for each type of measure, many of our results from the random effects analysis were confirmed. However, some of the changes such as that of the QWB-SA were no longer significant. While restricting the sample in this manner allows for more direct comparisons of change between measures and direct calculation of effect sizes, it also reduces the sample size and discards quite a bit of analyzable data. In fact, the sample size of the QWB-SA data in Table 5 was reduced from about 300 to 213 because of data missing on other measures. As shown in Table 1, the SF-36v2™ had the most missing data which is likely an artifact of the SF-36v2™ scoring system which is less tolerant of missing data. Given this likely explanation, there is no reason to expect systematic attrition between measures. Thus, both analytic approaches have benefits, but the random effects results in Table 2 appear most representative of the parameters studied for this sample.

Limitations of this study include significant attrition between baseline and the 1-month assessment (~16%). However, the sample size remained adequate to power the statistical analyses. Further, we studied a relatively small sample of volunteers from only three academic institutions. Thus, we are uncertain that these results can be generalized to the larger diverse population of adults with cataract disease.

In summary, the NEI-VFQ25 total score and 11 of its' 12 subscales were sensitive to the increases in HRQOL that are expected to accompany cataract surgery. Three preference-based HRQOL measures (HUI2, HUI3, and QWB-SA) were also sensitive to these changes. These measures are useful for describing HRQOL with a single total score and conducting cost-effectiveness analysis. The SF-36v2™, SF-6D, and EQ5D showed little responsiveness to cataract surgery. Researchers assessing HRQOL and conducting cost-effectiveness analyses should consider these findings when choosing an HRQOL assessment instrument.

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References

1. Congdon N, O'Colmain B, Klaver CC, Klein R, Munoz B, Friedman DS, et al. Causes and prevalence of visual impairment among adults in the United States. *Arch Ophthalmol*. 2004; 122(4): 477–485. [PubMed: 15078664]
2. Thylefors B, Negrel AD, Pararajasegaram R, Dadzie KY. Global data on blindness. *Bull World Health Organ*. 1995; 73(1):115–121. [PubMed: 7704921]
3. McCarty CA, Keeffe JE, Taylor HR. The need for cataract surgery: projections based on lens opacity, visual acuity, and personal concern. *Br J Ophthalmol*. 1999; 83(1):62–65. [PubMed: 10209437]
4. Congdon N, Vingerling JR, Klein BE, West S, Friedman DS, Kempen J, et al. Prevalence of cataract and pseudophakia/aphakia among adults in the United States. *Arch Ophthalmol*. 2004; 122(4):487–494. [PubMed: 15078665]
5. Steinberg EP, Bergner M, Sommer A, Anderson GF, Bass EB, Canner J, et al. Variations in cataract management: patient and economic outcomes. *Health Serv Res*. 1990; 25(5):727–731. [PubMed: 2254087]
6. Javitt J, Brauweiler HP, Jacobi KW, Klemen U, Kohnen S, Quentin CD, et al. Cataract extraction with multifocal intraocular lens implantation: clinical, functional, and quality-of-life outcomes. Multicenter clinical trial in Germany and Austria. *J Cataract Refract Surg*. 2000; 26(9):1356–1366. [PubMed: 11020621]

7. Branch LG, Horowitz A, Carr C. The implications for everyday life of incident self-reported visual decline among people over age 65 living in the community. *Gerontologist*. 1989; 29(3):359–365. [PubMed: 2788109]
8. Brenner MH, Curbow B, Javitt JC, Legro MW, Sommer A. Vision change and quality of life in the elderly. Response to cataract surgery and treatment of other chronic ocular conditions. *Arch Ophthalmol*. 1993; 111(5):680–685. [PubMed: 8489453]
9. Carabellese C, Appollonio I, Rozzini R, Bianchetti A, Frisoni GB, Frattola L, et al. Sensory impairment and quality of life in a community elderly population. *J Am Geriatr Soc*. 1993; 41(4): 401–407. [PubMed: 8463527]
10. Cutler SJ, Grams AE. Correlates of self-reported everyday memory problems. *J Gerontol*. 1988; 43(3):S82–90. [PubMed: 3361099]
11. Stelmack J. Quality of life of low-vision patients and outcomes of low-vision rehabilitation. *Optom Vis Sci*. 2001; 78(5):335–342. [PubMed: 11384011]
12. Tsai SY, Cheng CY, Hsu WM, Su TP, Liu JH, Chou P. Association between visual impairment and depression in the elderly. *J Formos Med Assoc*. 2003; 102(2):86–90. [PubMed: 12709736]
13. Wang JJ, Mitchell P, Smith W, Cumming RG, Attebo K. Impact of visual impairment on use of community support services by elderly persons: the Blue Mountains Eye Study. *Invest Ophthalmol Vis Sci*. 1999; 40(1):12–19. [PubMed: 9888421]
14. Mangione CM, Phillips RS, Lawrence MG, Seddon JM, Orav EJ, Goldman L. Improved visual function and attenuation of declines in health-related quality of life after cataract extraction. *Arch Ophthalmol*. 1994; 112(11):1419–1425. [PubMed: 7980131]
15. Applegate WB, Miller ST, Elam JT, Freeman JM, Wood TO, Gettlefinger TC. Impact of cataract surgery with lens implantation on vision and physical function in elderly patients. *Jama*. 1987; 257(8):1064–1066. [PubMed: 3806895]
16. Bernth-Petersen P. Outcome of cataract surgery I. A prospective, observational study. *Acta Ophthalmol (Copenh)*. 1982; 60(2):235–242. [PubMed: 7136534]
17. Donderi DC, Murphy SB. Predicting activity and satisfaction following cataract surgery. *J Behav Med*. 1983; 6(3):313–328. [PubMed: 6663617]
18. Legro MW. Quality of life and cataracts: a review of patient-centered studies of cataract surgery outcomes. *Ophthalmic Surg*. 1991; 22(8):431–443. [PubMed: 1923293]
19. Murphy SB, Donderi DC. Predicting the success of cataract surgery. *J Behav Med*. 1980; 3(1):1–14. [PubMed: 7401171]
20. Stark WJ, Sommer A, Smith RE. Changing trends in intraocular lens implantation. *Arch Ophthalmol*. 1989; 107(10):1441–1444. [PubMed: 2803089]
21. Uusitalo RJ, Brans T, Pessi T, Tarkkanen A. Evaluating cataract surgery gains by assessing patients' quality of life using the VF-7. *J Cataract Refract Surg*. 1999; 25(7):989–994. [PubMed: 10404378]
22. Elam JT, Graney MJ, Applegate WB, Miller ST, Freeman JM, Wood TO, et al. Functional outcome one year following cataract surgery in elderly persons. *J Gerontol*. 1988; 43(5):M122–126. [PubMed: 3418032]
23. Schein OD, Steinberg EP, Cassard SD, Tielsch JM, Javitt JC, Sommer A. Predictors of outcome in patients who underwent cataract surgery. *Ophthalmology*. 1995; 102(5):817–823. [PubMed: 7777281]
24. Sletteberg O, Hovding G, Bertelsen T. Do we operate too many cataracts? The referred cataract patients' own appraisal of their need for surgery. *Acta Ophthalmol Scand*. 1995; 73(1):77–80. [PubMed: 7627764]
25. Steinberg EP, Tielsch JM, Schein OD, Javitt JC, Sharkey P, Cassard SD, et al. National study of cataract surgery outcomes. Variation in 4-month postoperative outcomes as reflected in multiple outcome measures. *Ophthalmology*. 1994; 101(6):1131–1140. discussion 1140–1131. [PubMed: 8008355]
26. Desai P, Reidy A, Minassian DC, Vafidis G, Bolger J. Gains from cataract surgery: visual function and quality of life. *Br J Ophthalmol*. 1996; 80(10):868–873. [PubMed: 8976696]

27. Javitt JC, Brenner MH, Curbow B, Legro MW, Street DA. Outcomes of cataract surgery. Improvement in visual acuity and subjective visual function after surgery in the first, second, and both eyes. *Arch Ophthalmol.* 1993; 111(5):686–691. [PubMed: 8489454]
28. Ellwein LB, Urato CJ. Use of eye care and associated charges among the Medicare population: 1991–1998. *Arch Ophthalmol.* 2002; 120(6):804–811. [PubMed: 12049587]
29. Javitt JC, Zhou Z, Willke RJ. Association between vision loss and higher medical care costs in Medicare beneficiaries costs are greater for those with progressive vision loss. *Ophthalmology.* 2007; 114(2):238–245. [PubMed: 17270673]
30. Klein R, Klein BE, Moss SE. Age-related eye disease and survival. The Beaver Dam Eye Study. *Arch Ophthalmol.* 1995; 113(3):333–339. [PubMed: 7887847]
31. McCarty CA, Nanjan MB, Taylor HR. Vision impairment predicts 5 year mortality. *Br J Ophthalmol.* 2001; 85(3):322–326. [PubMed: 11222339]
32. Thompson JR, Sparrow JM, Gibson JM, Rosenthal AR. Cataract and survival in an elderly nondiabetic population. *Arch Ophthalmol.* 1993; 111(5):675–679. [PubMed: 8489452]
33. Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds. 2005. Annual Report of the Boards of Trustees.
34. Lee PP, Hilborne L, McDonald L, Tobacman JK, Kolder H, Johnson T, et al. Documentation patterns before cataract surgery at ten academic centers. *Ophthalmology.* 1996; 103(8):1179–1183. [PubMed: 8764784]
35. Mangione CM, Lee PP, Pitts J, Gutierrez P, Berry S, Hays RD. Psychometric properties of the National Eye Institute Visual Function Questionnaire (NEI-VFQ). NEI-VFQ Field Test Investigators. *Arch Ophthalmol.* 1998; 116(11):1496–1504. [PubMed: 9823352]
36. McLeod SD. Beyond snellen acuity: the assessment of visual function after refractive surgery. *Arch Ophthalmol.* 2001; 119(9):1371–1373. [PubMed: 11545646]
37. Scott IU, Schein OD, West S, Bandeen-Roche K, Enger C, Folstein MF. Functional status and quality of life measurement among ophthalmic patients. *Arch Ophthalmol.* 1994; 112(3):329–335. [PubMed: 8129657]
38. Steinberg EP, Tielsch JM, Schein OD, Javitt JC, Sharkey P, Cassard SD, et al. The VF-14. An index of functional impairment in patients with cataract. *Arch Ophthalmol.* 1994; 112(5):630–638. [PubMed: 8185520]
39. Mangione CM, Lee PP, Gutierrez PR, Spritzer K, Berry S, Hays RD. Development of the 25-item National Eye Institute Visual Function Questionnaire. *Arch Ophthalmol.* 2001; 119(7):1050–1058. [PubMed: 11448327]
40. Bremond-Gignac D, Tixier J, Missotten T, Laroche L, Beresniak A. [Evaluation of the quality of life in ophthalmology]. *Presse Med.* 2002; 31(34):1607–1612. [PubMed: 12426979]
41. Gall C, Mueller I, Kaufmann C, Franke GH, Sabel BA. [Visual field defects after cerebral lesions from the patient's perspective: health- and vision-related quality of life assessed by SF-36 and NEI-VFQ]. *Nervenarzt.* 2008; 79(2):185–194. [PubMed: 17934709]
42. Kuang TM, Hsu WM, Chou CK, Tsai SY, Chou P. Impact of stereopsis on quality of life. *Eye (Lond).* 2005; 19(5):540–545. [PubMed: 15319791]
43. Parrish RK 2nd. Visual impairment, visual functioning, and quality of life assessments in patients with glaucoma. *Trans Am Ophthalmol Soc.* 1996; 94:919–1028. [PubMed: 8981717]
44. Owsley C, McGwin G Jr, Scilley K, Meek GC, Seker D, Dyer A. Impact of cataract surgery on health-related quality of life in nursing home residents. *Br J Ophthalmol.* 2007; 91(10):1359–1363. [PubMed: 17522143]
45. Kaplan RM, Tally S, Hays RD, Feeny D, Ganiats TG, Palta M, et al. Five preference-based indexes in cataract and heart failure patients were not equally responsive to change. *J Clin Epidemiol.* 2011; 64(5):497–506. [PubMed: 20685077]
46. Kind, P. The EuroQol instrument: an index of health-related quality of life. In: Spilker, B., editor. *Quality of Life and Pharmacoeconomics in Clinical Trials.* Philadelphia, PA: Lippincott-Raven; 1996.
47. Shaw JW, Johnson JA, Coons SJ. US valuation of the EQ-5D health states: development and testing of the D1 valuation model. *Med Care.* 2005; 43(3):203–220. [PubMed: 15725977]

48. Feeny D, Furlong W, Boyle M, Torrance GW. Multi-attribute health status classification systems. Health Utilities Index. Pharmacoeconomics. 1995; 7(6):490–502. [PubMed: 10155335]
49. Torrance GW, Feeny DH, Furlong WJ, Barr RD, Zhang Y, Wang Q. Multiattribute utility function for a comprehensive health status classification system. Health Utilities Index Mark 2. Med Care. 1996; 34(7):702–722. [PubMed: 8676608]
50. Feeny D, Furlong W, Torrance GW, Goldsmith CH, Zhu Z, DePauw S, et al. Multiattribute and single-attribute utility functions for the health utilities index mark 3 system. Med Care. 2002; 40(2):113–128. [PubMed: 11802084]
51. Kaplan RM, Sieber WJ, Ganiats TG. The quality of well-being scale: Comparison of the interviewer- administered version with a self-administered questionnaire. Psych Health. 1997; 12:783–791.
52. Kaplan RM, Bush JW, Berry CC. Health status: types of validity and the index of well-being. Health Serv Res. 1976; 11(4):478–507. [PubMed: 1030700]
53. Ware JE Jr, Gandek B. Overview of the SF-36 Health Survey and the International Quality of Life Assessment (IQOLA) Project. J Clin Epidemiol. 1998; 51(11):903–912. [PubMed: 9817107]
54. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992; 30(6):473–483. [PubMed: 1593914]
55. Kosinski M, Keller SD, Hatoum HT, Kong SX, Ware JE Jr. The SF-36 Health Survey as a generic outcome measure in clinical trials of patients with osteoarthritis and rheumatoid arthritis: tests of data quality, scaling assumptions and score reliability. Med Care. 1999; 37(5 Suppl):MS10–22. [PubMed: 10335740]
56. Keller SD, Ware JE Jr, Hatoum HT, Kong SX. The SF-36 Arthritis-Specific Health Index (ASHI): II. Tests of validity in four clinical trials. Med Care. 1999; 37(5 Suppl):MS51–60. [PubMed: 10335743]
57. Scott-Lennox JA, Wu AW, Boyer JG, Ware JE Jr. Reliability and validity of French, German, Italian, Dutch, and UK English translations of the Medical Outcomes Study HIV Health Survey. Med Care. 1999; 37(9):908–925. [PubMed: 10493469]
58. Stewart, AL.; JEW. Measuring Functioning and Well-Being: The Medical Outcomes Study Approach. Durham: Duke University Press; 1992.
59. Brazier J, Roberts J, Deverill M. The estimation of a preference-based measure of health from the SF-36. J Health Econ. 2002; 21(2):271–292. [PubMed: 11939242]

Figure 1.
VFQ Total Score and Subscale

Figure 2.
SF-36 Summary Score and Subscale

Figure 3.
Preference-based measures of HRQOL

Table 1

Number of Participants at Each Time Point

	Baseline	1-month	6-month
HUI2	352	306	290
HUI3	355	304	289
QWB-SA	376	315	302
EQ5D	369	308	288
NEI-VFQ25 total	361	309	293
SF-36v2™	351	298	286

Table 2

Random Effects Data using all available data

	Baseline	1-month	6-month	p- value
NEI-VFQ25				
Total score **	71.7 (70.2, 73.1)	81.2 (79.8, 72.3)	83.4 (82.3, 84.6)	< 0.001
General vision **	44.3 (42.6, 46.1)	69.4 (67.1, 71.2)	72.8 (70.6, 75.0)	< 0.001
Distance **	78.1 (76.3, 79.9)	89.4 (87.8, 90.9)	91.4 (90.0, 92.7)	< 0.001
Driving **	76.2 (74.3, 78.2)	86.2 (84.3, 88.1)	89.1 (87.6, 90.6)	< 0.001
Dependency **	84.5 (82.4, 86.5)	91.6 (90.0, 93.2)	94.0 (92.5, 95.5)	< 0.001
Color vision **	88.5 (86.4, 90.6)	95.2 (93.7, 96.7)	96.4 (95.2, 97.7)	< 0.001
Mental health **	77.4 (75.5, 79.4)	87.2 (85.5, 88.9)	90.8 (89.4, 92.3)	< 0.001
Near vision **	66.8 (64.4, 69.2)	78.9 (76.6, 81.3)	84.5 (82.4, 86.6)	< 0.001
Pain **	79.7 (77.7, 81.7)	86.3 (84.6, 88.0)	89.1 (87.5, 90.7)	< 0.001
Peripheral **	69.1 (66.6, 71.6)	82.8 (80.4, 85.2)	83.7 (81.5, 85.9)	< 0.001
Role **	48.6 (46.9, 50.3)	52.1 (50.7, 53.5)	54.6 (53.1, 56.1)	< 0.001
Social **	85.5 (83.7, 87.3)	93.0 (91.6, 94.4)	93.7 (92.4, 95.0)	< 0.001
General health	59.8 (57.5, 46.1)	62.0 (59.4, 64.6)	59.3 (56.7, 61.8)	0.186
SF-36v2™				
PCS	45.6 (44.4, 46.7)	45.5 (44.4, 46.7)	44.8 (43.6, 46.0)	0.119
MCS	53.1 (52.0, 54.2)	52.9 (51.7, 54.1)	53.5 (52.4, 54.7)	0.481
Physical Function	71.0 (68.3, 73.7)	71.2 (68.4, 74.0)	68.8 (65.8, 71.7)	0.026
Role-Physical	73.0 (70.1, 75.8)	71.0 (68.1, 73.9)	72.1 (68.9, 75.2)	0.950
Bodily Pain	68.3 (65.9, 70.7)	70.3 (67.7, 72.9)	67.1 (64.5, 69.8)	0.271
General Health	68.7 (66.5, 70.8)	68.6 (66.2, 71.0)	68.1 (65.7, 70.5)	0.163
Vitality	62.6 (60.4, 64.7)	61.9 (59.6, 64.2)	62.3 (59.9, 64.8)	0.699
Social Function	83.8 (81.5, 86.1)	82.7 (80.2, 85.3)	82.9 (80.2, 85.6)	0.437
Role-Emotional	86.6 (84.3, 88.8)	85.8 (83.2, 88.3)	84.8 (82.2, 87.4)	0.205
Mental Health	78.6 (76.7, 80.5)	79.5 (77.5, 81.4)	80.7 (78.8, 82.6)	0.068
Preference-Based Measures				
EQ5D *	0.83 (0.81, 0.84)	0.85 (0.83, 0.87)	0.82 (0.80, 0.84)	0.033
HUI2 *	0.79 (0.77, 0.80)	0.82 (0.80, 0.84)	0.82 (0.80, 0.84)	0.018
HUI3 **	0.66 (0.63, 0.69)	0.72 (0.69, 0.75)	0.72 (0.69, 0.75)	< 0.001
QWB-SA **	0.59 (0.58, 0.61)	0.61 (0.60, 0.63)	0.62 (0.61, 0.66)	< 0.001
SF-6D	0.74 (0.72, 0.75)	0.73 (0.72, 0.75)	0.74 (0.73, 0.76)	0.269

* significant linear trend at $p < .05$,** significant at $p < .001$

Table 3

NEI-VFQ25-14 Mean differences across two intervals

NEI-VFQ25 Scales	Mean difference 1-month – baseline (n = 297)	SD	p-value	effect size (d)	Mean difference 6-month – 1-month (n = 257)	SD	p-value	effect size (d)
Total score *	8.74	11.33	<0.001	0.772	1.92	7.40	<0.001	0.259
General vision *	24.04	21.68	<0.001	1.109	3.35	17.85	0.003	0.188
Distance *	11.00	15.90	<0.001	0.692	1.98	10.91	0.011	0.181
Driving *	9.36	18.34	<0.001	0.510	2.69	14.70	0.003	0.183
Dependency *	5.92	16.82	<0.001	0.352	1.30	11.12	0.027	0.117
Color vision *	5.47	19.21	<0.001	0.285	1.56	11.38	0.031	0.137
Mental health *	8.69	16.18	<0.001	0.537	2.89	11.31	<0.001	0.256
Near vision *	11.00	23.59	<0.001	0.466	5.19	19.71	<0.001	0.263
Pain *	5.81	18.64	<0.001	0.312	2.63	13.27	<0.001	0.198
Peripheral *	13.30	23.79	<0.001	0.559	0.88	18.00	0.371	0.049
Role *	2.95	15.37	0.001	0.192	1.61	11.40	0.042	0.141
Social *	6.27	12.88	<0.001	0.487	1.02	8.88	0.074	0.115
General health	1.09	14.71	0.201	0.074	-2.04	17.07	0.048	-0.12

* significant at $p < .05$,** significant at $p < .001$

Table 4

SF-36v2™ Mean differences across two intervals

SF-36v2™ Subscales	Mean difference 1-month – baseline (n = 288)	SD	p-value	effect size (d)	Mean difference 6-month – 1-month (n = 246)	SD	p-value	effect size (d)
PCS	-0.17	6.66	0.623	-0.025	-0.29	7.11	0.997	-0.041
MCS	-0.59	7.52	0.095	-0.078	0.49	8.48	0.246	0.058
Physical Function	-0.29	16.81	0.816	-0.017	-1.36	18.19	0.100	-0.075
Role-Physical	-2.62	22.51	0.126	-0.117	2.74	24.72	0.032	0.111
Bodily Pain	1.22	18.01	0.262	0.067	-1.93	20.77	0.115	-0.093
General Health	-0.49	12.58	0.420	-0.039	-0.52	13.82	0.761	-0.037
Vitality	-0.69	14.45	0.422	-0.048	0.50	15.61	0.292	0.032
Social Function	-2.52	19.61	0.019	-0.128	0.97	21.60	0.609	0.045
Role-Emotional	-2.00	18.93	0.089	-0.106	-0.27	21.89	0.937	-0.012
Mental Health	0.32	12.66	0.557	0.025	1.08	13.87	0.224	0.078

Table 5

Preference-Based Measures of HRQOL - Mean differences across two intervals

Preference-Based QOL Measures	Mean difference 1-month – baseline (n = 254)	SD	p-value	effect size (d)	Mean difference 6-month – 1-month (n = 213)	SD	p-value	effect size (d)
EQ5D	0.018	0.123	0.176	0.147	-0.028	0.139	0.003	-0.202
HUI2	0.029	0.142	<0.001	0.202	0.007	0.149	0.634	0.044
HUI3	0.048	0.214	<0.001	0.226	0.011	0.210	0.773	0.054
QWB-SA	0.014	0.123	0.0536	0.110	0.004	0.113	0.554	0.032
SF-6D	-0.004	0.091	0.715	-0.047	0.003	0.099	0.227	0.035