The Economic Impact of Blue Light Filtering Intraocular Lenses on Age-Related Macular Degeneration Associated with Cataract Surgery

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Background and Objective

- Age-related macular degeneration (AMD) is the leading cause of blindness in patients ≥60 years in industrialized countries. The prevalence of AMD is strongly age-related with some 1%, 5%, and 13% of individuals ≥65, 75, and 84 years, respectively, reported to have the condition. AMD patients experience progressive loss of vision, a profound decrease in quality of life and a significant economic burden.
- There are few approved treatments available for AMD and their efficacy is limited to slow disease progression. Prevention of AMD by modifying risk factors has the potential to improve clinical and quality of life outcomes and reduce downstream healthcare costs due to the relatively expensive treatment of AMD.
- One of the risk factors for AMD is the exposure to blue light that can damage the retina. AMD has been associated with cataract surgery during which the natural human lens, that has the ability to filter blue light, is extracted and replaced with a clear intraocular lens (IOL) that lacks the ability to filter blue light.
- Blue light filtering lenses (BLF IOLs) have the potential to reduce the development of AMD following cataract surgery. A recent editorial by Niikawa (2016) recommended that BLF IOLs can be considered to replace the natural lens during cataract surgery.
- A BLF lens, AcrySof IQ™ (Alcon Laboratories Inc.) that mirrors the natural human lens has recently become available. The objective of this study was to determine the potential of BLF IOLs to reduce the development of AMD after cataract surgery from the U.S. payer’s perspective.

Methods

- A decision analytical model was developed to assess the outcomes per eye receiving one of two types of IOLs (Table 2) over a 5-year period.
- The study population was patients who underwent cataract surgery and aged 55 years or older. It was further stratified by age group into 55 to 64 years, 65 to 74 years, and ≥75 years based on patient age at the time of cataract surgery, with each cohort having a different risk of developing AMD.
- Outcomes were assessed for the three representative cohorts of 100 eyes over a time horizon of 5 years. For each IOL option, eyes could then develop AMD (geographic atrophy or exudative) or remain free of AMD during the five-year period. For patients with geographic atrophy AMD, no active treatment was applied. Exudative AMD was treated with laser photocoagulation, verteporfin, or peptides. All patients (with AMD or no AMD) received an annual ophthalmic visit plus an annual follow-up visit.
- Preclinical studies support the protective effect of BLF IOLs in a study in humans, BLF IOLs decrease transmission of blue light by 50%.

Discussion

- There was a reduced risk of developing AMD in the 5-year period after the cataract surgery and the additional cost of the BLF IOL is completely offset by the lower costs associated with AMD management. The extent of this benefit is highly dependent on the age of the patient, or more specifically, baseline risk of AMD.

Results

- The sensitivity analysis results for the ≥75-year-old age group are presented in Table 2. This cohort was selected as these patients represent the majority of the population undergoing cataract surgery.

Key References


Table 1: Model Inputs

| Clinical Inputs | Percentage of AMD patients w/exudative AMD | 50% | 35% | 65%* |

Table 2: AMD Incidence and Total Costs Over 5 Years Per 100 Eyes: BLF IOL vs. Non-BLF IOL (Stratified By Age)

| Age group | BLF IOLs – Cost | Non-BLF IOLs – Cost | Savings

Table 3. Sensitivity analysis (n=100)

| Model Parameter | Pegaptanib cost | Percentage of patients with exudative AMD | Total costs

Figure 1. Model Structure and Costs Associated with Age-Related Macular Degeneration

- The incidence of AMD increased with age regardless of IOL implanted, however, the incidence of AMD was consistently lower in the BLF IOL group compared with the non-BLF group (Table 2).
- The costs associated with AMD and AMD are shown in Figure 1. The BLF IOL cohort had lower total costs during the first 5-year post-surgery period compared with the non-BLF cohort for all age groups (Table 2).
- The total incident costs associated with BLF IOLs for 100 eyes were $4,275, $26,997 and $111,734 in the 55 to 64-year-old, 65 to 74-year-old and ≥75 year-olds, respectively. Thus, the additional cost of the BLF IOL was offset by the reduced cost of managing AMD (Table 2).

Sensitivity Analysis

- For all three age groups, the top five most influential variables on the cost savings were identified. (1) Odds ratio of AMD after cataract surgery (2) AMD risk reduction by BLF IOL (3) Age-specific risk of AMD (4) Efficacy cost and (5) percentage of patients who develop exudative AMD.
- The sensitivity analysis results for the ≥75-year-old age group are presented in Table 2. This cohort was selected as these patients represent the majority of the population undergoing cataract surgery.

Key Model Assumptions

- The cost of cataract surgery and risk of surgical complications were considered to be the same regardless of the type of IOL implanted.
- AMD developed in the middle of the 5-year follow-up period (i.e., 2.5 years). Only costs after 2.5 years were assessed as costs were considered to be the same in all groups prior to the development of AMD.
- Due to the limited data available, all exudative AMD patients who were eligible to receive laser photocoagulation (10%) and verteporfin (5%) were assumed to receive these treatments while the balance were considered to receive pegaptanib. Fluorescein angiography and fundus photography monitoring procedures were restricted at each visit for all exudative AMD patients.

Clinical Model Input

- The key clinical model inputs are presented in Table 1.
- Two incidence-based epidemiological studies conducted in the Beaver Dam area of the United States and the Blue Mountain region of Australia confirmed the association between cataract surgery and AMD.
- The odds ratio of developing AMD following cataract surgery was obtained from the 5-year pooled Beaver Dam and Blue Mountain studies. These studies were chosen based on methodological strength (incidence-based), robust sample size (n=6,519) and being geographic representative. The relative risk and attributable risk of AMD due to cataract surgery were then determined.
- Preclinical studies support the protective effect of BLF IOLs in a study in humans, BLF IOLs decrease transmission of blue light by 50%.

Economic Inputs

- The management of AMD was restricted to treatment available by the United States Food and Drug Administration (AMD treatment) and expert clinical opinion.