# Prior Authorization Review Panel
## MCO Policy Submission

A separate copy of this form must accompany each policy submitted for review. Policies submitted without this form will not be considered for review.

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<th>Plan: Aetna Better Health</th>
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**Type of Submission – Check all that apply:**

- [ ] New Policy
- [x] Revised Policy*
- [ ] Annual Review – No Revisions
- [ ] Statewide PDL

*All revisions to the policy must be highlighted using track changes throughout the document.

Please provide any clarifying information for the policy below:

**CPB 0713 Artificial Retina**

Clinical content was never revised. No additional non-clinical updates were made by Corporate since the last PARP submission.

<table>
<thead>
<tr>
<th>Name of Authorized Individual (Please type or print):</th>
<th>Signature of Authorized Individual:</th>
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<tbody>
<tr>
<td>Dr. Bernard Lewin, M.D.</td>
<td>Bernard Lewin, M.D.</td>
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Artificial Retina

**Number: 0713**

**Policy**

*Please see amendment for Pennsylvania Medicaid at the end of this CPB.*

Aetna considers artificial retina devices (e.g., the Argus II) experimental and investigational because there is insufficient scientific evidence of the safety and effectiveness of these devices in restoring vision.

**Background**

Researchers have been testing microelectronic retinal implants as a method of restoring vision in patients rendered blind by degenerative diseases of the retina such as retinitis pigmentosa (RP) and age-related macular degeneration (ARMD). Tests of electrical stimulation of the retinal surface have demonstrated that such stimulation may induce light sensation. These studies have shown that retinal neurons are preserved after death of photoreceptors in retinitis pigmentosa.

Two types of retinal implant systems are under development: (i) *epiretinal implants*, designed to communicate directly with the ganglion and bipolar cells; and (ii) *subretinal implants*, designed to replace photoreceptors in the retina. Both types of implants are intended to restore some vision through electrical stimulation of functional neurons in the retina. Retinal implants require an intact optic nerve pathway to allow them to function. Both systems translate incoming light, whether from a camera or the environment, to electrical stimulation of the functional neurons in the retina.
Epiretinal implants are positioned on the surface of the retina and receive light signals from external camera systems. An electronic chip camera mounted in the frame of special glasses captures images and transmits the images via electrical impulses to a second chip, which is implanted in the retina. Epiretinal implant systems may include other components such as image processing electronics, a telemetry system to provide power and data to the implanted subsystems, implanted electronics for signal decoding and stimulus generation, and an electrode array to deliver the electrical charge to the retina.

Subretinal implants are positioned behind the retina and receive light directly from the environment. In this approach, light is converted into electrical signals that stimulate remnant cell layers of the retina.

The first Argus retinal prosthesis was labeled the Argus 16 since it consisted of 16 electrodes attached to the back of the retina. It was created by Second Sight Inc. (Sylmar, CA) as a means of restoring sight to the blind. The Argus 16 device (also known as Argus I) was a complex arrangement of inter-connected devices. Similar to the virtual sight devices, the Argus implant also used spectacles. It consisted of a miniature camera and transmitter mounted in the rims of the spectacles, an implanted receiver that receives the output of that camera, as well as an electrode-studded array secured to the retina with a micro-tack. A wireless microprocessor and battery pack worn on the belt powered the entire arrangement. The principal difference between the Argus implant and virtual sight devices was that Argus connects to the retina, whereas virtual sight connects to the optic nerve directly. As a consequence, the Argus implant requires a natural eyeball to still be in place, and cannot work with those lacking such. The camera was capable of capturing images in far greater detail than the electrode array was capable of sending to the brain. The 16 electrodes, arranged in a 4 X 4 pattern, could only produce a very tiny visual area, and literally a display of 4 pixels by 4 pixels, of the outside world. Thus, the Argus implant only offer vague shadows and light impressions. However, when compared with blindness, such ability may be beneficial. In 2007, clinical trials began on the Argus I’s replacement, the Argus II.

Ahuja et al (2011) examined to what extent subjects implanted with the Argus II retinal prosthesis can improve performance compared with residual native vision in a spatial-motor task. High-contrast square stimuli (5.85 cm sides) were displayed in random locations on a 19 inches (48.3 cm) touch screen monitor located 12 inches (30.5 cm) in front of the subject. Subjects were instructed to locate and touch the square center with the system on and then off (40 trials each). The coordinates of the square center and location touched were recorded. A total of 96 % (26/27) of subjects reported a significant improvement in accuracy and 93 % (25/27) demonstrated a significant improvement in repeatability with the system on compared with off (p < 0.05, Student t test). A group of 5 subjects that had both accuracy and repeatability
values less than 250 pixels (7.4 cm) with the system off (i.e., using only their residual vision) was significantly more accurate and repeatable than the remainder of the cohort (p < 0.01). Of this group, 4 subjects showed a significant improvement in both accuracy and repeatability with the system on. The authors concluded that in a study on the largest cohort of visual prosthesis recipients to date, these investigators found that artificial vision augments information from existing vision in a spatial-motor task.

Weiland et al (2011) stated that degenerative diseases such as ARMD and RP primarily affect the photoreceptors, ultimately resulting in significant loss of vision. Retinal prostheses aim to elicit neural activity in the remaining retinal cells by detecting and converting light into electrical stimuli that can then be delivered to the retina. The concept of visual prostheses has existed for more than 50 years and recent progress shows promise, yet much remains to be understood about how the visual system will respond to artificial input after years of blindness that necessitate this type of prosthesis. In this review, the authors focused on 3 major areas: (i) the histopathologic features of human retina affected by ARMD and RP, (ii) current results from clinical trials, and (iii) challenges to overcome for continued improvement of retinal prostheses. They noted that "the routine nature of intraocular lens implantation today belies decades of hard-won surgical and biomaterial advances. Retinal prostheses are following a similar roadmap, and to realize their full potential, we have to allow time not only for the clinical and biological testing, but also for engineering and technical advances".

In a single-arm, prospective, multi-center clinical trial, Humayun and colleagues (2012) evaluated the Argus II Retinal Prosthesis System (Second Sight Medical Products, Inc,) in blind subjects with severe outer retinal degeneration. A total of 30 subjects were enrolled in this study. All subjects were followed-up for a minimum of 6 months and up to 2.7 years. The electronic stimulator and antenna of the implant were sutured onto the sclera using an encircling silicone band. Next, a pars plana vitrectomy was performed, and the electrode array and cable were introduced into the eye via a pars plana sclerotomy. The microelectrode array then was tacked to the epiretinal surface. The primary safety end points for the trial were the number, severity, and relation of serious adverse events (SAEs). Principal performance end points were assessments of visual function as well as performance on orientation and mobility tasks. Subjects performed statistically better with the system "on" versus "off" in the following tasks: object localization (96 % of subjects), motion discrimination (57 %), and discrimination of oriented gratings (23 %). The best recorded visual acuity to date is 20/1,260. Subjects’ mean performance on orientation and mobility tasks was significantly better when the system was "on" versus "off"; 70 % of the patients did not have any SAEs. The most common SAE reported was either conjunctival erosion or dehiscence over the extra-ocular implant and was treated successfully in all subjects except in 1, who required explantation of the device without further
complications. The authors concluded that the long-term safety results of Second Sight’s retinal prosthesis system are acceptable, and most subjects with profound visual loss perform better on visual tasks with system than without it. It is unclear whether these statistically better findings are translated into better clinical outcomes. The results of this small feasibility study need to be validated by further investigations.

Barry and Dagnelie (2012) studied the capabilities of the Argus II retinal prosthesis for guiding fine hand movement, and demonstrated and quantified guidance improvement when using the device over when not using the device for progressively less predictable trajectories. A total of 21 patients with RP, remaining vision no more than bare light perception, and an implanted Argus II epi-retinal prostheses used a touch-screen to trace white paths on black backgrounds. Sets of paths were divided into 3 categories: (i) right-angle/single-turn, (ii) mixed-angle/single-turn, and (iii) mixed-angle/two-turn. Subjects trained on paths by using prosthetic vision and auditory feedback, and then were tested without auditory feedback, with and without prosthetic vision. Custom software recorded position and timing information for any contact that subjects made with the screen. The area between the correct path and the trace, and the elapsed time to trace a path were used to evaluate subject performance. For right-angle/single-turn sets, average tracing error was reduced by 63 % and tracing time increased by 156 % when using the prosthesis, relative to residual vision. With mixed-angle/single-turn sets, error was reduced by 53 % and time to complete tracing increased by 184 %. Prosthesis use decreased error by 38 % and increased tracing time by 252 % for paths that incorporated two turns. The authors concluded that use of an epi-retinal visual prosthesis can allow RP patients with no more than bare light perception to guide fine hand movement visually. Further, prosthetic input tends to make subjects slower when performing tracing tasks, presumably reflecting greater effort.

Dorn et al (2013) investigated the ability of 28 blind subjects implanted with a 60-electrode Argus II (Second Sight Medical Products, Inc., Sylmar, CA) retinal prosthesis system to detect the direction of a moving object. Blind subjects (bare light perception or worse in both eyes) with RP were implanted with the Argus II prosthesis as part of a phase 1/2 feasibility study at multiple clinical sites worldwide. The experiment measured their ability to detect the direction of motion of a high-contrast moving bar on a flat-screen monitor in 3 conditions: (i) with the prosthesis system on and a 1-to-1 mapping of spatial information, (ii) with the system off, and (iii) with the system on but with randomly scrambled spatial information. Fifteen subjects (54 %) were able to perform the task significantly better with their prosthesis system than they were with their residual vision, 2 subjects had significantly better performance with their residual vision, and no difference was found for 11 subjects. Of the 15 better-performing subjects, 11 were available for follow-up testing, and 10 of them had significantly better performance with normal rather than with scrambled spatial information. The authors concluded that these findings demonstrated...
that blind subjects implanted with the Argus II retinal prosthesis were able to perform a motion
detection task they could not do with their native vision, confirming that electrical stimulation of
the retina provides spatial information from synchronized activation of multiple electrodes.

On February 14, 2013, the Food and Drug Administration (FDA), under humanitarian device
exemption (HDE), approved the Argus II Retinal Prosthesis System, the first implanted device to
treat adult patients with advanced RP. The device, which includes a small video camera,
transmitter mounted on a pair of eyeglasses, video processing unit (VPU) and an implanted
retinal prosthesis (artificial retina), replaces the function of degenerated cells in the retina and
may improve a patient’s ability to perceive images and movement. The VPU transforms images
from the video camera into electronic data that is wirelessly transmitted to the retinal prosthesis.
An HDE exempts the device from a review of clinical effectiveness. The FDA concluded the
Argus II Retinal Prosthesis System will not expose blind individuals with severe outer retinal
degeneration to an unreasonable or significant risk of illness or injury. The FDA concluded the
initial data demonstrated a probable benefit that out-weighed the risks of the device.

An UpToDate review on “Retinitis pigmentosa: Treatment” (Garg, 2013) states that “One retinal
prosthesis system (Argus II) converts video images captured from a very small camera housed
in the patient’s glasses, into a series of small electrical impulses that are wirelessly transmitted to
an array of 60 electrodes on the retina. Argus II was approved for use in Europe in 2011 and is
undergoing review by the US Food and Drug Administration in 2012. Newer generations of
prostheses have increasingly more electrodes, with one in the development phase with over
1000 electrodes. Retinal prostheses have the potential to enhance the quality of life of RP
patients by aiding in object recognition, mobility, and independent living …. Experimental
approaches to treatment for RP, under active investigation, include gene therapy, transplantation
of fetal retinal cells or stem cells, and electronic retinal prostheses”.

Kotecha et al (2014) evaluated the reach-to-grasp performance of patients fitted with an
epiretinal artificial retina device. This was a hospital-based case series consisting of 6 patients
fitted with the Argus II retinal prosthesis. Participants were asked to reach out and pick up a
high-contrast cuboid object with the prosthesis in the “On”, “Off” or “Scrambled” setting presented
in a randomized order. The “Scrambled” setting consisted of a random, scattered signal
presented to the prosthesis. The session was repeated after a 4- to 6-week period. Hand
movements were measured using motion detection cameras. The number of successful object
grasps was calculated. The number of successful grasps was greater with the prosthesis in the
“On” setting (visit 1: median [interquartile range] percentage success: “Off” = 0 [0 to 50] %, “On”
= 69 [67 to 95] %, “Scrambled” = 59 [42 to 95] %; Friedman Chi-squared test statistic 6.5, p =
0.04 ; visit 2 median [IQR] percentage success: “Off” = 0 [0 to 25] %, “On” = 69 [53 to 100] %,
“Scrambled” = 28 [13 to 63] %; Friedman Chi-squared test statistic 8.4, p = 0.02). The authors
concluded that the use of an electronic retinal prosthesis facilitated reach-and-grasp performance. Moreover, they stated that further work should explore how performance can be improved with targeted rehabilitation.

Stronks and Dagnelie (2014) stated that visual prostheses are devices to treat profound vision loss by stimulating nerve cells anywhere along the visual pathway, typically with electrical pulses. The Argus II implant, developed by Second Sight Medical Products (SSMP, Sylmar, CA), targets the retina and features 60 electrodes that electrically stimulate the surviving retinal neurons. Of the approximately 20 research groups that are actively developing visual prostheses, SSMP has the longest track record. The Argus II was the first visual prosthesis to become commercially available: it received the European conformity (Conformité Européenne [CE]) marking in March 2011 and FDA approval was granted in February 2013 for humanitarian use in the USA. Meanwhile, the Argus II safety/benefit study has been extended for research purposes, and is still ongoing.

Luo and da Cruz (2014) stated that the Argus® II is the first retinal prosthesis approved for the treatment of patients blind from RP, receiving CE marking in 2011 and FDA approval in 2013. Alpha-IMS followed closely and obtained CE marking in July 2013. Other devices are being developed, some of which are currently in clinical trials. These investigators performed a systematic literature search on PubMed, Google Scholar and IEEExplore. Retinal prostheses play a part in restoring vision in blind RP patients providing stable, safe and long-term retinal stimulation. However, objective improvement in visual function does not always translate into consistent improvement in the patient’s quality of life. Controversy exists over the use of an external image-capturing device versus internally placed photo-diode devices. The authors concluded that improvement in retinal prosthetic vision depends on: (i) improving visual resolution, (ii) improving the visual field, (iii) developing an accurate neural code for image processing, and (iv) improving the biocompatibility of the device to ensure longevity.

Chuang et al (2014) noted that retinal implants present an innovative way of restoring sight in degenerative retinal diseases. Previous reviews of research progress were written by groups developing their own devices. This systematic review objectively compared selected models by examining publications describing 5 representative retinal prostheses: (i) Argus II, (ii) Boston Retinal Implant Project, (iii) Epi-Ret 3, (iv) Intelligent Medical Implants (IMI), and (v) Alpha-IMS (Retina Implant AG). Publications were analyzed using 3 criteria for interim success: (a) clinical availability, (b) vision restoration potential and (c) long-term biocompatibility. Argus II is the only device with FDA approval. Argus II and Alpha-IMS have both received the European CE marking. All others are in clinical trials, except the Boston Retinal Implant, which is in animal studies. Resolution theoretically correlates with electrode number. Among devices with external
cameras, the Boston Retinal Implant leads with 100 electrodes, followed by Argus II with 60 electrodes and visual acuity of 20/1262. Instead of an external camera, Alpha-IMS uses a photo-diode system dependent on natural eye movements and can deliver visual acuity up to 20/546. IMI offers iterative learning; Epi-Ret 3 is a fully intra-ocular device; Alpha-IMS uses intra-ocular photo-sensitive elements. Merging the results of these 3 criteria, Alpha-IMS is the most likely to achieve long-term success decades later, beyond current clinical availability. 

Currently, there is insufficient evidence that the use of artificial retina devices result in improved useful vision. Available data are limited to small, short-term, feasibility studies. Furthermore, no professional medical society has recommended the use of artificial retina devices.

The Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP-S)’s Technology Brief on “Argus II Retinal Prosthesis System for peripheral retinal degeneration” (2013) stated that “The evidence on the safety and effectiveness of the Argus II Retinal Prosthesis System considered in this Technology Brief is of a low level, being derived from the same group of 30 patients enrolled in the same phase two clinical trial. Given that the device is in its initial stage of assessment and the studies included in this Technology Brief are derived from the first clinical trial to assess the safety and efficacy of the device, the initial results are promising ….. Although the results from the studies included in this Technology Brief were promising, they were all derived from the same multicentre, phase II clinical trial of only 30 patients. HealthPACT therefore recommend that this technology be monitored for 24 months, in which time additional evidence may become available”.

In an interventional case-series study, Rizzo et al (2014) studied the anatomic and functional outcomes of Argus II Retinal Prosthesis System implantation in patients with RP. The study population included 6 patients with visual acuity (VA) no better than light perception. After the Argus II Retinal Prosthesis System was implanted, complications and anatomic and functional results were studied. The main outcome measures were mobility, square localization, direction of motion, grating VA, and Goldmann visual field, all of which were assessed. Optical coherence tomography (OCT) was performed. Implantation of the Argus II Retinal Prosthesis System was safely performed in all patients. One patient experienced post-operative elevation in intra-ocular pressure (IOP), which was controlled medically. In 1 patient, moderate detachment of the choroid occurred post-operatively, and it resolved spontaneously. One patient withdrew from the study. Wound dehiscence, endophthalmitis or retinal detachment was not observed. All patients were able to locate a bright light on the ceiling and a dark line on the floor after the surgery. Performance in square localization tests improved in 4 patients, and direction of motion improved in 3 patients; 1 patient achieved grating VA. Goldmann visual field test results improved in all patients. The authors concluded that patients showed improvement in visual tasks after the surgery, and the device was well-tolerated and functional over a 1-year follow-up period. They
stated that a rigorous patient-selection process is necessary to maximize patient compliance with the rigorous follow-up testing schedule. Both patients and medical staff should be prepared for a lengthy, arduous rehabilitation process. While the results of this small case-series study (n = 6) are promising, prospective randomized trials with long-term follow-up are needed to ascertain the safety and effectiveness of retinal prosthetic devices.

Sabbah et al (2014) explored the visual environment through head-scanning movements in subjects fitted with a retinal prosthesis connected to a head-mounted camera (camera-connected prosthesis [CC-P]). As eye and camera misalignment might alter the spatial localization of images generated by the device, these researchers investigated if such misalignment occurred in blind subjects wearing a CC-P and whether it impacted spatial localization, even years after the implantation. These investigators studied 3 subjects blinded by RP, fitted with a CC-P (Argus II) 4 years earlier. Eye/head movements were video recorded as subjects tried to localize a visual target. Pointing coordinates were collected as subjects were requested to orient their gaze toward pre-determined directions, and to point their finger to the corresponding perceived spot locations on a touch screen. Finally, subjects were asked to give a history of their everyday behavior while performing visually controlled grasping tasks. Misaligned head and gaze directions occurred in all subjects during free visual search. Pointing coordinates were collected in 2 subjects and showed that median pointing directions shifted toward gaze direction. Reportedly all subjects were unable to accurately determine their eye position, and they developed adapted strategies to perform visually directed movements. The authors concluded that eye position affected perceptual localization of images generated by the Argus II prosthesis, and consequently visuo-motor coordination, even 4 years following implantation. Affected individuals developed strategies for visually guided movements to attenuate the impact of eye and head misalignment. These observations provided indications for rehabilitation procedures and for the design of upcoming retinal prostheses.

Weiland and Humayun (2014) stated that retinal prosthesis has been translated from the laboratory to the clinic over the past 20 years. Currently, 2 devices have regulatory approval for the treatment of RP. These devices provide partial sight restoration and patients use this improved vision in their everyday lives. The authors noted that improved mobility and object detection are some of the more notable findings from the clinical trials. However, significant vision restoration will require both better technology and improved understanding of the interaction between electrical stimulation and the retina.

In a multi-center, single-arm, prospective clinical trial, Ho and co-workers (2015) evaluated the safety, reliability, and benefit of the Argus II Retinal Prosthesis System in restoring some visual function to subjects completely blind from RP. These investigators reported clinical trial results at 1 and 3 years after implantation. There were 30 subjects in 10 centers in the United States and
Europe. Subjects served as their own controls, that is, implanted eye versus fellow eye, and system on versus system off (native residual vision). The Argus II System was implanted on and in a single eye (typically the worse-seeing eye) of blind subjects. Subjects wore glasses mounted with a small camera and a video processor that converted images into stimulation patterns sent to the electrode array on the retina. The primary outcome measures were safety (the number, seriousness, and relatedness of AEs) and visual function, as measured by 3 computer-based, objective tests. A total of 29 of 30 subjects had functioning Argus II Systems implants 3 years after implantation; 11 subjects experienced a total of 23 serious device- or surgery-related AEs. All were treated with standard ophthalmic care. As a group, subjects performed significantly better with the system on than off on all visual function tests and functional vision assessments. The authors concluded that the 3-year results of the Argus II trial support the long-term safety profile and benefit of the Argus II System for patients blind from RP. They noted that earlier results from this trial were used to gain approval of the Argus II by the FDA and a CE mark in Europe.

Garcia and associates (2015) examined if blind individuals treated with a retinal prosthesis could also benefit from using the resultant new visual signal together with non-visual information when navigating. A total of 4 patients (blind for 15 to 52 years) implanted with the Argus II retinal prosthesis, and 5 age-matched and 6 younger controls, participated. Subjects completed a path reproduction and a triangle completion navigation task, using either an indirect visual landmark and non-visual self-motion cues or non-visual self-motion cues only. Control subjects wore goggles that approximated the field of view and the resolution of the Argus II prosthesis. In both tasks, control subjects showed better precision when navigating with reduced vision, compared to without vision. Patients, however, did not show similar improvements when navigating with the prosthesis in the path reproduction task, but two patients did show improvements in the triangle completion task. Additionally, all patients showed greater precision than controls in both tasks when navigating without vision. The authors concluded that these findings indicated that the Argus II retinal prosthesis may not provide sufficiently reliable visual information to improve the precision of patients on tasks, for which they have learnt to rely on non-visual senses.

Gekeler and colleagues (2015) noted that electrical stimulation (ES) has a long history in ophthalmology. Sub-threshold ES can have beneficial therapeutic effects on hereditary degenerative retinal diseases. Supra-threshold stimulation is able to elicit visual perceptions and, if multi-electrode fields are arranged as an array, usable pictures can be perceived by blind patients. These investigators reviewed the current situation and studies on therapeutic trans-corneal ES. Moreover, they discussed challenges, surgical concepts and visual results of active retinal implants. These researchers provided an overview on trans-corneal ES and active retinal implants based on published results, with special emphasis on the clinical application. The results of initial controlled studies on therapeutic trans-corneal ES in hereditary retinal diseases
were very promising. The largest controlled study so far in patients with RP has yielded many positive trends and some significant improvements in electrophysiological data. Currently, 2 retinal implants have regulatory approval, the Argus II retinal prosthesis system and the Alpha-IMS. Both systems can be used to improve visual perception and under test conditions can achieve visual acuities of 0.02 and 0.04, respectively. The authors concluded that in-depth analyses and follow-up studies in larger patient groups are currently planned to definitively clarify the potential of therapeutic trans-corneal ES in RP patients. They stated that the challenges of currently available active retinal implants are the technical bio-stability and the limited spatial resolution.

Luo and da Cruz (2016) stated that the Argus II Retinal Prosthesis System is the first prosthetic vision device to obtain regulatory approval in both Europe and the United States. As such it has entered the commercial market as a treatment for patients with profound vision loss from end-stage outer retinal disease, predominantly RP. To-date, over 100 devices have been implanted worldwide, representing the largest group of patients currently treated with visual prostheses. The system works by direct stimulation of the relatively preserved inner retina via epi-retinal microelectrodes, thereby replacing the function of the degenerated photoreceptors. Visual information from a glasses-mounted video camera is converted to a pixelated image by an external processor, before being transmitted to the microelectrode array at the macula. Elicited retinal responses are then relayed via the normal optic nerve to the cortex for interpretation.

These investigators reviewed the animal and human studies that led to the development of the Argus II device. A sufficiently robust safety profile was demonstrated in the phase I/II clinical trial of 30 patients. Improvement of function in terms of orientation and mobility, target localization, shape and object recognition, and reading of letters and short unrehearsed words have also been shown. There remains a wide variability in the functional outcomes among the patients and the factors contributing to these performance differences are still unclear. They stated that future developments in terms of both software and hardware aimed at improving visual function have been proposed; further experience in clinical outcomes is being acquired due to increasing implantation.

Seitz and colleagues (2016) stated that in ophthalmology, regenerative medicine is rapidly becoming a reality. Cell-based therapeutic strategies in end-stage retinal degeneration may be of therapeutic value, whatever the mechanism of disease mechanismm. However, while corneal transplantation is commonly performed with excellent results, many obstacles must be overcome before retinal transplants can become clinically useful. The major problems are the production of appropriate transplants and functional integration in-situ. New technologies allow the production of autologous transplants by inducing pluripotency in adult somatic cells. The authors concluded that driven by this development, exciting new research has been conducted on the development of artificial retinal tissue for basic research and transplantation.
Pei and associates (2016) noted that retinal prosthesis offers a potential treatment for individuals suffering from photoreceptor degeneration diseases. Establishing biological retinal models and simulating how the biological retina convert incoming light signal into spike trains that can be properly decoded by the brain is a key issue. Some retinal models have been presented, ranking from structural models inspired by the layered architecture to functional models originated from a set of specific physiological phenomena. However, most of these focused on stimulus image compression, edge detection and reconstruction, but did not generate spike trains corresponding to visual image. In this study, based on state-of-the-art retinal physiological mechanism, including effective visual information extraction, static non-linear rectification of biological systems and neurons Poisson coding, a cascade model of the retina including the outer plexiform layer for information processing and the inner plexiform layer for information encoding was brought forward, which integrated both anatomic connections as well as functional computations of retina. Using MATLAB software, spike trains corresponding to stimulus image were numerically computed by 4 steps: (i) linear spatiotemporal filtering, (ii) static non-linear rectification, (ii) radial sampling, and (iv) Poisson spike generation. The authors concluded that the simulated findings suggested that such a cascade model could recreate visual information processing and encoding functionalities of the retina, which is helpful in developing artificial retina for the retina blind.

Duncan and colleagues (2017) reported the change in quality of life (QOL) after treatment with the Argus II epiretinal prosthesis in patients with end-stage RP. The Vision and QOL Index (VisQOL) was used to assess changes in QOL dimensions and overall utility score in a prospective 30-patient single-arm clinical study. VisQOL is a multi-attribute instrument consisting of 6 dimensions (injury, life, roles, assistance, activity and friendship) that may be affected by visual impairment. Within each dimension, patients were divided into 2 groups based on how much their QOL was affected by their blindness at baseline (moderate/severe or minimal). Outcomes were compared within each dimension sub-group between baseline and the combined follow-up periods using the Friedman test. In addition, data from the 6 dimensions were combined into a single utility score, with baseline data compared to the combined follow-up periods. Overall, 80 % of the patients reported difficulty in 1 or more dimensions pre-implant. Composite VisQOL utility scores at follow-up showed no statistically significant change from baseline; however, in 3 of the 6 VisQOL dimensions (injury, life and roles), patients with baseline deficits showed significant and lasting improvement after implantation with Argus II. In 2 of the 3 remaining dimensions (assistance and activity), data trended toward an improvement. In the final VisQOL dimension (friendship), none of the patients reported baseline deficits, suggesting that patients had largely adjusted to this attribute. The authors concluded that patients whose vision negatively affected them with respect to 3 VisQOL dimensions (i.e., getting injured, coping with the demands of their life and fulfilling their life roles) reported significant improvement in
QOL after implantation of the Argus II retinal prosthesis. Furthermore, the benefit did not deteriorate at any point during the 36-month follow-up, suggesting a long-term, durable improvement.

The authors noted that the drawbacks of this study included the small sample size (n = 30), reflecting the rarity of RP and limited patient information available at baseline for use as possible co-variates (including the level of previous rehabilitation, training and support). In particular, understanding the extent of prior rehabilitation would have been helpful in explaining the disparity in baseline utility and domain scores, although this would not have affected the change in QOL scores after treatment. They stated that it is unlikely that any single outcome measure represented a full picture of the benefit of the Argus II system for any particular patient. It is important to note that the VisQOL was one of a battery of visual function and functional vision outcome measures used in this clinical trial, all of which together showed an overall trend of benefit from the Argus II system.

Cheng and co-workers (2017) noted that to-date, reviews of retinal prostheses have focused primarily on devices undergoing human trials in the Western Hemisphere and failed to capture significant advances in materials and engineering research in countries such as Japan and Korea, as well as projects in early stages of development. To address these gaps, this systematic review examined worldwide advances in retinal prosthetic research, evaluated engineering characteristics and clinical progress of contemporary device initiatives, and identified potential directions for future research in the field of retinal prosthetics. These researchers carried out a literature search using PubMed, Google Scholar, and IEEExplore following the PRISMA guidelines for systematic review. Inclusion criteria were peer-reviewed papers demonstrating progress in human or animal trials and papers discussing the prosthetic engineering design. For each initiative, a description of the device, its engineering considerations, and recent clinical results were provided. A total of 10 prosthetic initiatives met inclusion criteria and were organized by stimulation location. Of these initiatives, 4 have recently completed human trials, 3 are undergoing multi- or single-center human trials, and 3 are undergoing pre-clinical animal testing. Only the Argus II (FDA 2013, CE 2011) has obtained FDA approval for use in the US; the Alpha-IMS (CE 2013) has achieved the highest VA using a Landolt-C test to-date and is the only device presently undergoing a multi-center clinical trial. The authors concluded that several distinct approaches to retinal stimulation have been successful in eliciting visual precepts in animals and/or humans. However, many clinical needs are still not met and engineering challenges must be addressed before a retinal prosthesis with the capability to fully and safely restore functional vision can be realized.
Furthermore, an UpToDate review on “ (Garg, 2017) states that “Retinal prosthesis -- Devices are being tested that transduce light into electrical signals and transmit this information directly to the inner retina (bypassing the diseased outer retina of RP), optic nerve, or occipital visual cortex. Patients involved in studies of these devices have reported seeing flashes of light and have been able to sense motion, locate large objects, and recognize large letters. There are multiple retinal prostheses in clinical trials. One retinal prosthesis system (Argus II) converts video images captured from a very small camera housed in the patient’s glasses, into a series of small electrical impulses that are wirelessly transmitted to an array of 60 electrodes on the retina. Vision restoration is theoretically correlated with the number of electrodes. Newer generations of prostheses have increasingly more electrodes, with one in the development phase with over 1000 electrodes. Retinal prostheses have the potential to enhance the quality of life of RP patients by aiding in object recognition, mobility, and independent living”.

CPT Codes / HCPCS Codes / ICD-10 Codes

Information in the [brackets] below has been added for clarification purposes. Codes requiring a 7th character are represented by "+":

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<tr>
<td>0100T</td>
<td>Placement of a subconjunctival retinal prosthesis receiver and pulse generator, and implantation of intra-ocular retinal electrode array, with vitrectomy</td>
</tr>
<tr>
<td>0472T</td>
<td>Device evaluation, interrogation, and initial programming of intra-ocular retinal electrode array (eg, retinal prosthesis), in person, with iterative adjustment of the implantable device to test functionality, select optimal permanent programmed values with analysis, including visual training, with review and report by a qualified health care professional</td>
</tr>
<tr>
<td>0473T</td>
<td>Device evaluation and interrogation of intra-ocular retinal electrode array (eg, retinal prosthesis), in person, including reprogramming and visual training, when performed, with review and report by a qualified health care professional</td>
</tr>
<tr>
<td></td>
<td>HCPCS codes not covered for indications listed in the CPB:</td>
</tr>
<tr>
<td>C1841</td>
<td>Retinal prosthesis, includes all internal and external components</td>
</tr>
<tr>
<td>C1842</td>
<td>Retinal prosthesis, includes all internal and external components; add-on to C1841</td>
</tr>
<tr>
<td>L8608</td>
<td>Miscellaneous external component, supply or accessory for use with the argus ii retinal prosthesis system</td>
</tr>
<tr>
<td></td>
<td>ICD-10 codes not covered for indications listed in the CPB:</td>
</tr>
<tr>
<td>Code</td>
<td>Code Description</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>E08.311 - E08.39</td>
<td>Diabetes mellitus due to underlying condition with ophthalmic complications [retinopathy]</td>
</tr>
<tr>
<td>E09.311 - E09.39</td>
<td>Drug or chemical induced diabetes mellitus with ophthalmic complications [retinopathy]</td>
</tr>
<tr>
<td>E10.311 - E10.39</td>
<td>Type 1 diabetes mellitus with ophthalmic complications [retinopathy]</td>
</tr>
<tr>
<td>E11.311 - E11.39</td>
<td>Type 2 diabetes mellitus with ophthalmic complications [retinopathy]</td>
</tr>
<tr>
<td>E13.311 - E13.39</td>
<td>Other specified diabetes mellitus with ophthalmic complications [retinopathy]</td>
</tr>
<tr>
<td>H31.101 - H31.129</td>
<td>Choroidal degeneration</td>
</tr>
<tr>
<td>H33.001 - H35.9</td>
<td>Retinal detachments and breaks, retinal vascular occlusions and other retinal disorders</td>
</tr>
</tbody>
</table>

The above policy is based on the following references:


42. Garg S. Retinitis pigmentosa: Treatment. UpToDate [online serial]. Waltham, MA: UpToDate; reviewed May 2017.
There are no amendments for Medicaid.