The goal is to prevent blindness in the more than 60 million people affected by glaucoma worldwide.

Glaucoma describes a range of disorders in which the final common pathway is rapid, progressive ganglion cell death with resultant nerve fiber layer loss and increasing neuroretinal rim thinning leading to optic nerve dysfunction. Diagnosis is typically based on characteristic optic nerve head appearance in combination with class visual field defects often with elevated IOP. Medications, laser, and surgery may be used to lower IOP, currently the main modifiable risk factor. The greatest unmet needs are two-fold: 1) detecting the disease earlier, because patients experience symptoms only when the disease is advanced and current treatments cannot reverse ganglion cell loss, and 2) identifying patients at highest risk for rapid progression of the disease, so treatment interventions with various risk profiles can be tailored to the rate of vision loss with the goal of avoiding functional blindness.

Applications of New Technology to the Field of Glaucoma

The time is ripe for technological advances because diagnostic and treatment tools are increasingly available. These include portable screening tools such as optical coherence tomography (OCT) and OCT angiography (OCT-A); new medications; lasers; and microinvasive glaucoma surgeries (MIGS). Advances in machine learning and artificial intelligence are making it possible to aggregate various sources of clinical data and to apply algorithms to develop patient risk stratification models. Fast and compact imaging tools and mobile solutions are enabling more rapid, convenient screening and detection of glaucoma. Monitoring is progressing, but slowly, because it requires changes in how glaucoma progression is measured, which need to be validated with longitudinal studies. Biomarkers and new drug delivery technologies offer the promise of improving treatment outcomes. Telemedicine and mobile health can be used for remote detection, diagnosis, and management.

Investments in Innovative Technologies

Santen, a global specialty ophthalmology company, is dedicated to improving the eyesight and health of people around the globe. Santen not only creates tangible products but also innovative services and processes. Santen encourages the development of innovations through actively learning and applying best practices in the world. As part of this effort, Santen established the Global Innovation Office (IO) in 2015 headed by technology veteran Elo Kent. IO’s mission is to forge partnerships within both life sciences and technology ecosystems, including inventors, digital health startups, venture capitalists, and incubators, with a common goal to develop novel early stage technologies that solve patients’ unmet needs. Kent believes that new technologies can have the biggest impact on earlier disease detection, better monitoring of disease progression, improved treatment outcomes, and enhanced
patient compliance. Further to the commitment of innovation, Santen recently announced the establishment of a corporate venture fund to invest in early stage companies developing differentiated products in new and emerging technologies in pharmaceutical and non-pharmaceutical treatments for ophthalmic conditions. The newly established venture fund further enables the IO to engage with the technology ecosystem by way of seed and early equity investments that drive innovations to solve unmet patient and provider needs.

Part of its mission to explore and understand best practices and trends in ophthalmology care, the IO convened a group of leading glaucoma advisors to discuss insights on the best opportunities for investment. Focused on primary open-angle glaucoma (POAG), the advisors discussed the potential impact of new innovations on glaucoma diagnostics, disease progression, and treatment, and explored which tools and technologies hold the most promise for patients.

While they came from geographically diverse regions, the advisors shared a common vision for the future state of glaucoma care (Table). They were unanimous as to the importance of being able to predict a patient’s disease progression. With that shared objective in mind, they and the Santen team delved into the potential to develop patient risk stratification profiles and models. Advances in the application of machine learning algorithms and data analytics are paving the way for the development of profiles to identify the patients who will experience rapid glaucoma progression so that functional blindness can be avoided. The discussion focused on the need for a large shared data set and a priori agreed upon definitions of glaucoma. It has been difficult to achieve consensus on definitions due to the subjective nature of diagnosis and quality of life, according to Santen IO Advisor, Robert Chang, MD. Dr. Chang said the biggest issue is amassing a large enough data set among patients with fast progressing disease to harness deep learning to identify trends and patterns.

Though the advisors believe the current diagnostic and management tools, such as OCT and IOP monitoring, are valuable, they wish they had better methods for interpreting and ensuring the clinical meaning of their patients’ data. They discussed the role of improved imaging technologies combined with mobile devices and teledicine, which have the ability to expand patient access to early detection and better disease management. However, they pointed out that barriers to better treatment are related to reimbursement, liability, and patient acceptance, as opposed to technology adoption alone.

Santen’s IO has developed an approach for identifying and evaluating new innovations. Their approach is based on an adaptation of the glaucoma biologic care pathway integrated with the ophthalmologists’ workflow and the patient journey (Figure 1). This integrated schemata underpins the four pillars of innovation that Santen has identified as holding the greatest promise for earlier intervention and better patient outcomes:

- Earlier detection and diagnosis
- Predicting and monitoring progression
- Better treatments
- Improving patient compliance

**Key Findings on Innovations Addressing Unmet Needs**

Advisors and the Santen team examined and discussed the glaucoma care pathway and identified several areas of unmet need that would have the greatest impact on patient outcomes (Figure 2).
Technological Innovations

- The ability to stratify a patient’s risk of progression holds the promise of having a significant impact on patient outcomes because it directly affects the multitude of treatment options from which the doctor can choose. Ability to use risk stratification to predict which patients have rapidly progressing disease could help influence payers to cover surgery and medications.

According to Randy Craven, MD, “Over the recent years, structure and function together have increased our ability to detect glaucoma. Regardless, the importance of IOP control is still the standard. Moving toward minimally invasive surgery (that hopefully will become outpatient), improved drug delivery (potentially in devices), and targeted IOP monitoring (potentially in devices) will allow us to truly begin to tackle the problem of disease progression. We really have had trouble sorting out if it is IOP or forms of IOP issues (spikes or fluctuation) that lead to progression or if there are variables outside of IOP. Once we have an excellent platform for IOP control and monitoring, we can work on the other issues more effectively.”

The glaucoma community is poised to adopt and apply risk stratification algorithms based on machine learning and artificial intelligence into their practices. However, these new technologies face hurdles, including longitudinal data, more input sources such as home-based testing and compliance monitoring, and better surrogates for measuring ganglion cell death.

- Coupled with the need for better identification of patients at risk, is the need for better approaches to caring for patients with the most advanced glaucoma who are intractable to treatment. Once ophthalmologists are able to detect those at risk for disease progression, they need better treatment options to slow or halt their patients’ disease.

- IOP will continue to be a primary endpoint for glaucoma diagnostics, and continuous monitoring could provide important insights; however, more research is required to determine how best to apply the data gathered from monitoring to achieve better clinical outcomes.

- Contrary to popular belief, tools, such as mobile imaging, are not being widely adopted yet. A mobile image provides an isolated island of information that identifies a single parameter in a multifactorial disease, limiting its application to one patient at one moment in time. While more work needs to be done for mobile imaging to live up to the industry gold standard, its greatest application is in emerging markets, where more advanced technologies are not widely available and there are large populations in need of detection and diagnosis.

- OCTs are widely used and continuously advancing—manufacturers are designing devices that are smaller and faster. OCTs are not necessary in all clinics as there are other, less expensive means for diagnosis and monitoring.

- When it comes to patient quality of life, the ability to predict contrast loss or dynamic visual contrast is more meaningful than measurements of cellular loss. Vision loss progression impacts the patient’s ability to function.

Future Landscape

- While clinicians are mostly satisfied with the imaging capabilities of current OCTs, the development of less expensive alternatives, open-source software, and new data algorithms to enable the exploitation of machine learning and data analytics are still an unmet need. Dr. Chang suggested that telemedicine and mobile could be best leveraged to understand the interplay of multiple disease parameters such as applying artificial intelligence to interpret OCT data.

- Based on dynamics in the health care marketplace and the increasing prevalence of glaucoma, there is a growing concern that there will be regional shortages of ophthalmologists. Clearly, technology would play a critical role in extending and enhancing the eye care community’s ability to detect, treat, and monitor glaucoma and to improve patient compliance.

Challenges and Opportunities Along the Care Pathway: The Innovation Pillars

Santen’s IO has organized its technology investments around these four pillars with a focus on technologies that
Figure 3. By exploring these six technologies, Santen’s Innovation Office is able to address their four pillars—detection, monitoring, treatment, and compliance.

have short-term and medium-term impact (Figure 3). Interests in the portfolio include, but are not limited to, technologies that can have an immediate impact on improving patient screening and compliance in clinical trials and enable rapid detection and diagnosis of disease in the population. Santen partners with commercial entities such as technology companies as well as academic centers of excellence.

Santen is also exploring areas of innovation that reflect the company’s 127-year history in ophthalmology and its ongoing, sustained commitment to advancing eye care, globally:

• Supporting project, “10-10-10” with additional investments in technology and novel therapy (see 10-10-10 sidebar)
• Investing in research studies, including exploring development of a long-term prospective study of

10-10-10

The treatment armamentarium is improving with the latest in surgical devices, such as microinvasive glaucoma surgeries (MIGS), to treat more advanced cases of disease. A worldwide team of leading glaucoma experts, including Professor Sir Peng Khaw, MD, PhD, of the Moorfields Eye Hospital in London, are working on a project titled “10-10-10,” the audacious goal for glaucoma surgery. The goal? To achieve an IOP of 10 mm Hg that lasts at least 10 years with a surgical technique that can be performed in 10 minutes. This global multidisciplinary project is drawing new attention to the field. Santen is among the companies supporting this goal by incorporating it into their product development and technology investment plans. Santen’s MicroShunt is just one example of how Santen is delivering new glaucoma medications and devices to the market.

Professor Sir Peng stated, “It is an interesting strategic thing for you (Santen), that in terms of glaucoma, you happen to have in your hands at the moment, the device (MicroShunt) that has got the closest to achieving the 10-10-10 target.”

Next Steps

A new era in glaucoma care is here. Santen’s IO finds itself at the forefront of an opportunity to move the field forward as never before. The desired result? Better access and outcomes for patients and improved health care costs. Demand for better glaucoma care is at a peak given the aging population and the increase in disease prevalence. Technological advancements have us poised to address the areas of unmet need: providing earlier detection; determining those at risk for rapid progression; providing more effective, longer lasting treatments; and helping patients better monitor and manage their disease.

Santen is the eye care community’s partner in this journey to improve treatment outcomes. We are committed to sponsoring research and supporting advances in technology to slow the progression of glaucoma. We are actively exploring opportunities to engage with early stage innovative companies in order to enhance our pipeline and accelerate our vision to someday eradicate the devastating effects of glaucoma. Our goal is to eliminate glaucoma as the leading cause of blindness worldwide and render it a manageable chronic disease with no power to rob people of sight.

Let us start a dialogue. Santen’s IO would like to hear from you. Contact us at innovation@santen.com.

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As a specialty company dedicated to the ophthalmic field, Santen carries out research, development, marketing, and sales of pharmaceuticals and devices. Santen is the market leader in Japan for prescription ophthalmic pharmaceuticals and sells products in approximately 60 countries. As a leading company in the field of ophthalmology, Santen aims to contribute to society by supplying valuable products and services to satisfy unmet medical needs. For more details, please see Santen’s website (www.santen.com).