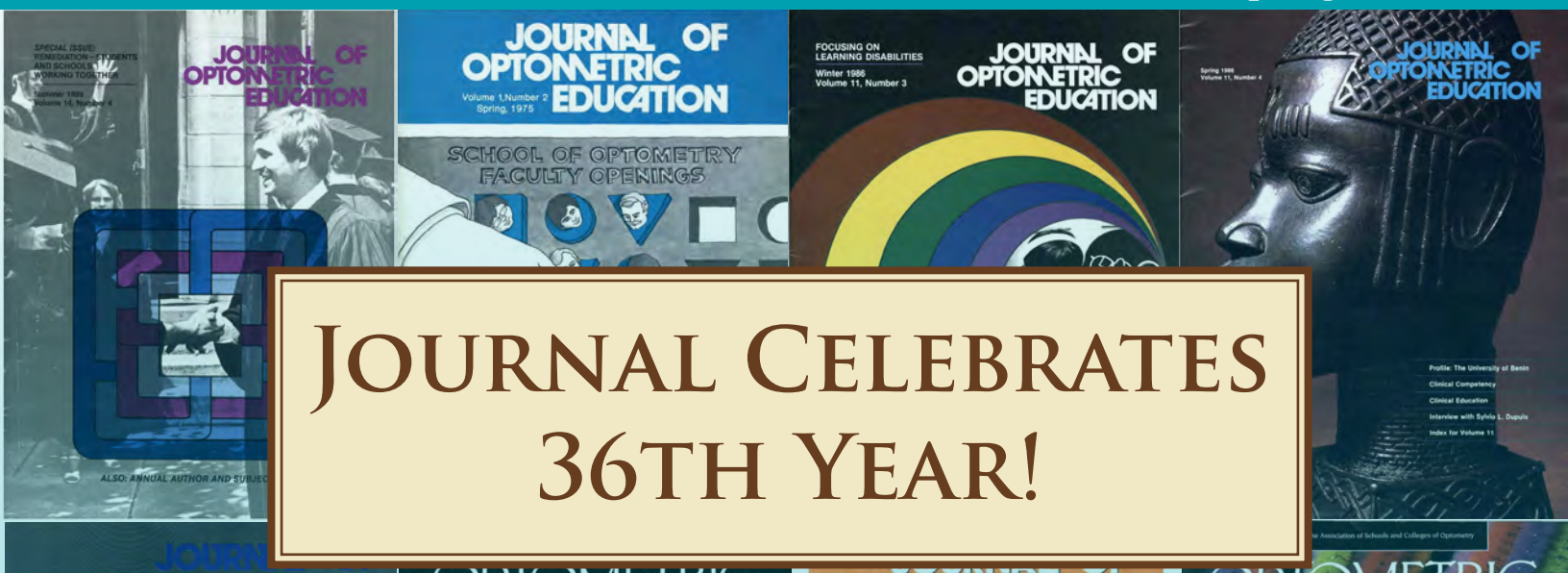
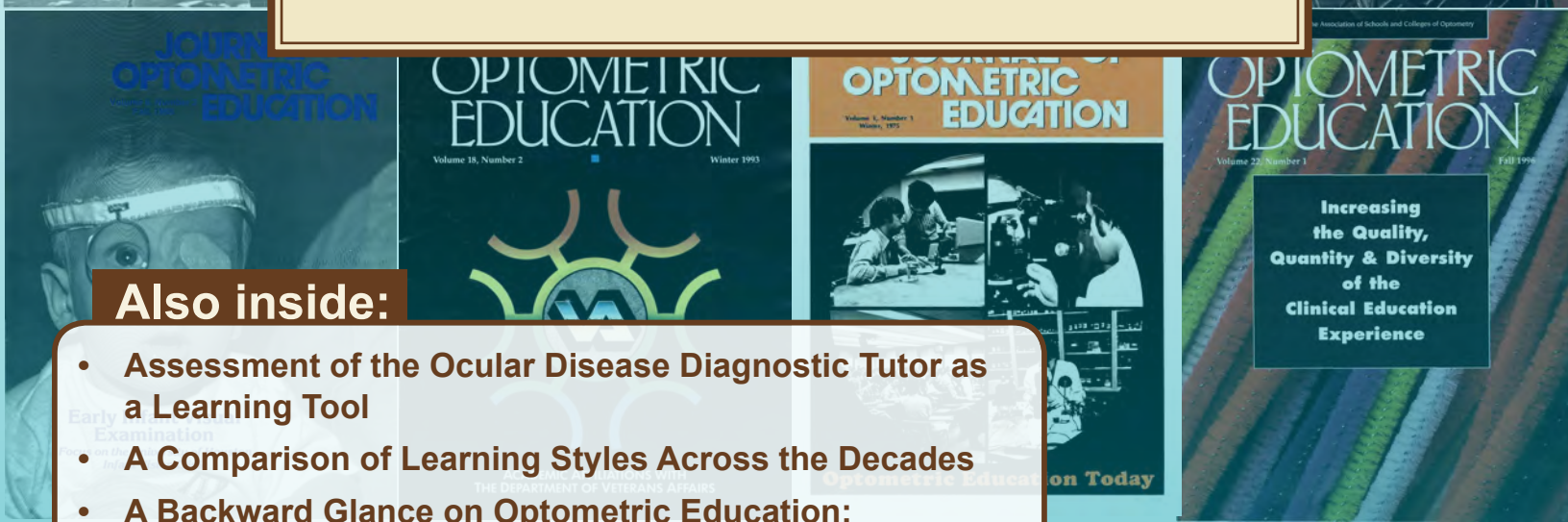
The Journal of the Association of Schools and Colleges of Optometry

OPTOMETRIC EDUCATION

Volume 36, Number 2 Winter/Spring 2011



Journal Celebrates 36th Year!



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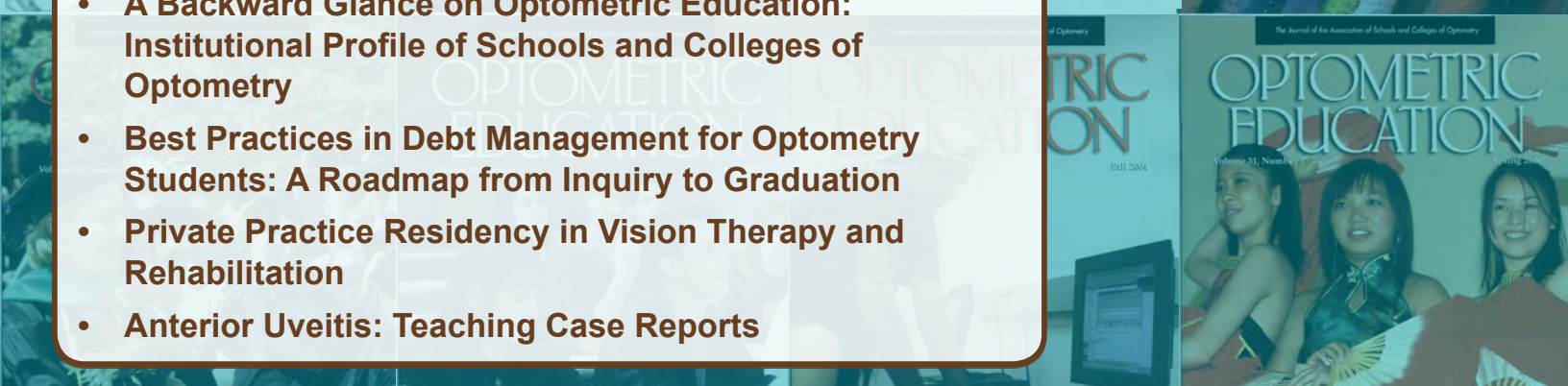

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2011

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FEATURES AND DEPARTMENTS

Past issues of Optometric Education *are available on the ASCO Web site at http://www.opted.org/i4a/pages/index.cfm?pageid=3404. Funding for archiving was generously provided by Transitions Optical.*

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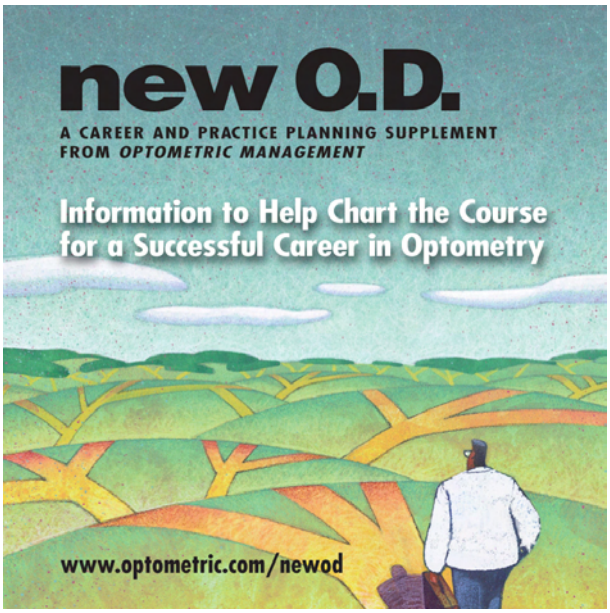

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INDUSTRY NEWS

The following companies support ASCO's national programs and activities benefiting the schools and colleges of optometry in the U.S. and Puerto Rico.

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New Silicone Hydrogel Wetting Agent Explored

Alcon®

Alcon is developing a new agent designed to improve the wettability properties of silicone hydrogel contact lenses. Data on the wetting agent, which uses proprietary polymer chemistry (polyoxyethylene-polyoxybutylene, or EOBO), was presented at the 2010 annual meeting of The Association for Research in Vision and Ophthalmology (Davis JW, Ketelson HA, Shows A, et al. A lens care solution designed for wetting silicone hydrogel materials. ARVO Program/Poster 3417/D1034. May 4, 2010, Fort Lauderdale, FL.).

According to the poster presented, a test solution containing EOBO reduced the surface and bulk hydrophobicity and improved the hydrophilic properties of silicone hydrogel lenses as compared to a saline solution control. In a press release, Alcon's Director of Consumer Product Research, Howard Ketelson, PhD, stated "Polyethylene oxide is the hydrophilic portion of the molecule and carries water efficiently and effectively to the hydrophobic lens sites that are not wetted by the tear film."

The company is also evaluating how the EOBO technology can be incorporated into its contact lens care product line.

New Web Resource Designed for ODs

ALLERGAN

As part of its "Made for Each Other" campaign, Allergan launched a Web site to provide optometrists with single-site access to information about the company's therapeutics and other resources. The site offers information about patient cost-saving programs such as rebates, unbranded disease state backgrounders for patient education, and practice management tools such as questionnaires and trackers to help doctors assess patients, get them started on treatment and track their progress. Visit www.allerganoptometry.com.

Also available from Allergan is the recently FDA-approved topical treatment for the prevention of itching associated with allergic conjunctivitis, alcaftadine ophthalmic solution 0.25% (Lastacaft). According to the company, the H1 histamine receptor antagonist is a completely new chemical entity. Lastacaft is a once-daily therapy and it is approved for use in pediatric patients over 2 years of age. In conjunctival allergen challenge studies, Lastacaft was more effective than its vehicle in preventing ocular itching at 3 minutes and 16 hours post-dosing. Full prescribing information can be found at www.accessdata.fda.gov/drugsatfda_docs/label/2010/022134s000lbl.pdf.

Lastacaft is a once-daily therapy for patients with allergic conjunctivitis.

Specialty Contact Lenses to be Marketed Worldwide

Bausch + Lomb has entered into an agreement with United Kingdom-based UltraVision CLPL to market and sell KeraSoft contact lenses throughout the world. KeraSoft lenses are a patented combination of the latest technologies in soft and silicone hydrogel materials. They utilize geometries from complex mathematics to offer comfortable wear and excellent vision to patients with irregular corneas and keratoconus. Each lens is custom designed for the individual eye.

Commenting on the announcement in a press release, Joseph Barr, OD, MS, FAAO, vice president of Global Clinical & Medical Affairs and Professional Services, Vision Care for B+L, said "This technology has totally transformed my view of contact lens management of keratoconus and irregular cornea patients. The visual results and enhancement of life are true advances."

The global roll-out of KeraSoft lenses through B+L's lab channel partners will begin later this year and will be executed around the world in phases.

Avaira Toric Contact Lens Available Nationwide

CooperVision announced the national rollout of Avaira Toric silicone hydrogel contact lenses. The design of the Avaira Toric combines a consistent horizontal thickness, an optimized ballast, naturally wettable material, a low modulus and high water content, all of which are aimed at providing consistent and comfortable performance in a broad range of astigmatic patients regardless of prescription.

The lenses are made of enfilcon A material and incorporate CooperVision's Aquaform Comfort Science technology. According to company materials, this technology creates a naturally hydrophilic contact lens that retains water, minimizing dehydration and eliminating the need for wetting agents, coatings or additives. Avaira Toric lenses have a Dk of 100 and a Dk/t of 91.

High-Definition Video BIO Debuts

New from Heine is the OMEGA 2C High Definition Video Binocular Indirect Ophthalmoscope. It features Xenon Halogen illumination and does not contain a beam splitter because the video camera is built into the instrument head itself. Heine said the OMEGA 2C is the only BIO on the market designed specifically for video applications.

The instrument's integrated Panasonic HD GP-KH232 camera utilizes a one-third-inch CMOS sensor to deliver a native 1080p resolution from HDMI output. It delivers 900 lines of resolution when viewed on a TV and true HD 1080p digital imaging on a computer.

Native American Student Scholarship Established

Hoya Vision Care and Northeastern State University have established the Wilma Mankiller Scholarship for Native American Students in the Oklahoma College of Optometry. Hoya will donate $25,000 over the next five years to provide funding for the scholarship.

In thanking Mankiller's family for allowing the scholarship to be named in her honor, NSUOCO Assistant Dean Michelle Welch, OD, pointed out that Mankiller, the former Principal Chief of the Cherokee Nation, was one of the first to put a priority on providing healthcare for the tribe.

The Wilma Mankiller Scholarship will be offered for the 2011-12 academic year. Applicants must be American Indian, hold a 3.0 cumulative grade point average and be entering the first or second year of studies at NSUOCO. First-year students will receive preference. The scholarship amount awarded will be determined based on the money generated by the fund. Half will be awarded for the fall semester and the second half for the spring semester if the student maintains a 3.0 GPA and performs 10 hours of approved volunteer optometry service each semester.

NSU welcomes donations to the scholarship. For more information, contact the NSU Foundation at (918) 458-2143 or foundation@nsuok.edu or visit www.nsugiving.com.

New Device, Software Enhance Retinal Imaging

Building off its P200 scanning laser ophthalmoscope device, Optos has developed a new retinal imaging system designed to deliver enhanced clinical information and tools for detecting pathology and monitoring changes in the retina over time. The new device, the 200Dx, and associated V2 Vantage Pro Software (v2.6) are expected to provide better overall image quality by way of several advancements, including retinal nerve fiber layer/ polarization – circular from linear, laser focus improvement, brighter images and superior field illumination, and an improved patient interface.

Additional software capabilities include historical image overlay for comparing current optomap exams with previous ones, archived information and the ability to e-mail patients a 3D Wrap video of their optomap image.

Dr. Schnider Takes On New Role at Vistakon

Vistakon, Division of Johnson & Johnson Vision Care, Inc., named Cristina M. Schnider, OD, MBA, FAAO, Senior Director, Medical Affairs. In this role, Dr. Schnider

is responsible for providing strategic direction and leadership for Medical Affairs in the area of specialty contact lens products. Dr. Schnider joined Vistakon in 1999 as Manager of Claims Substantiation and Product Assessment, Research & Development. She recently returned from a three-year assignment in Tokyo, Japan.

Cristina M. Schnider, OD, MBA, FAAO

In other news, Vistakon is reminding doctors about the availability of a free resource for patients from the Asthma & Allergy Foundation of America. The brochure, titled "Eye Health & Allergies," was supported by 1-Day Acuvue Moist contact lenses. It provides information to help patients understand and better manage their eye-related allergy problems.

To request a PDF of the brochure for use on your Web site, or to order a complimentary set of brochures (50) for your practice, e-mail eyeallergybrochure@rprmc.com. Requests should include your name and complete address, including ZIP code.

The "Eye Health & Allergies" brochure is a free resource from the Asthma & Allergy Foundation of America.

Spanish-Language Track Returns to Expo East

Transitions Optical is supporting a Spanish-language education track during International Vision Expo East for the second year. Six new courses, all approved for ABO credit, are included in the conference program. The track is open to all eyecare professionals who speak Spanish, either fluently or conversationally, from both the United States and Latin America. Course topics range from incorporating the latest eyewear technologies to practice-building and dispensing tips.

After International Vision Expo East (March 18-20, Jacob J. Javits Center, New York City) all Spanish-language courses will be posted to the Education section of Transitions Optical's professional trade portal at www.Transitions.com/PRO.

Transitions also recently announced the promotion of Brian Hauser, PhD, to the position of General Manager, U.S. and Canada. Hauser's responsibilities for the North American region include strategic planning, business growth and organization leadership. Chief Operating Officer Dave Cole said "Brian's extensive optical industry experience, coupled with his ability to build strong relationships internally and externally, makes him an ideal choice for this role. His leadership of the North American region will ensure we continue to create synergies and customer alignment across all levels of the channel to accelerate business growth."

Brian Hauser, PhD

Scholarship Competition Judging is Under Way

Judging of this year's entries into the Walmart Project Foresight scholarship competition is under way. Optometry students in their first, second or third year of school are competing by designing and developing a business plan for an optometric practice that promotes the profession of optometry, incorporates the teachings from the schools and colleges of optometry and highlights the values of Walmart Health and Wellness. Each team, made up of two students, also creates a presentation to showcase its business plan. A panel of school and Walmart officials judges the entries at each participating school. The winning team from each school wins a $1,000 scholarship and a chance to compete in the national competition for the grand prize, a $20,000 scholarship.

The winners of the 2011 competition will be announced later this year. Questions about the contest can be directed to Kim Vo, OD, at kimuyen.vo@wal-mart.com or (479) 426-3979.


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The Partnership Foundation for Optometric Education is planting, cultivating, and nurturing. Together, this "true partnership" of state, regional, and national organizations is making a long-term investment in tomorrow. With the investment we make today in optometric education, future generations of practitioners will flourish.

For more information, contact the Partnership Foundation at www.opted.org or 301-231-5944, ext 3018.

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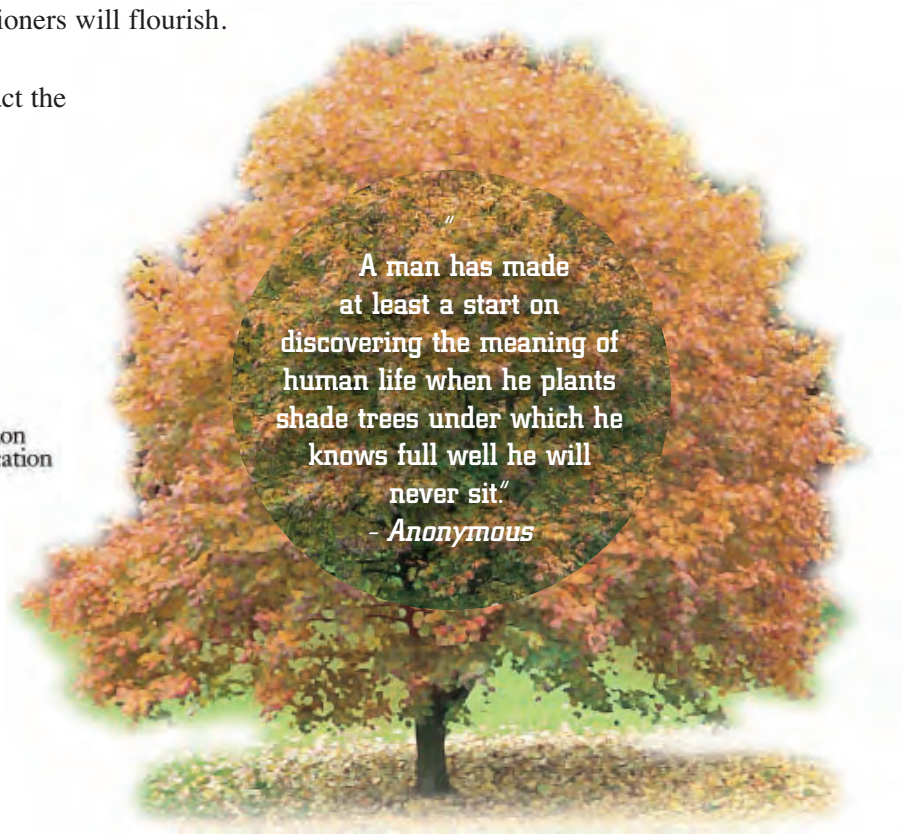

EDITORIAL

Reflections on the Past

Aurora Denial, OD, FAAO

In 1974, the Association of Schools and Colleges of Optometry (ASCO) established a national office. One of the first responsibilities of the fledgling office was to establish a journal to serve as a forum for dissemination of information related to optometric education. In the winter of 1975, the first edition of the *Journal of Optometric Education* was printed. This year we celebrate the publication's 36th anniversary.

To gain a deeper appreciation of the value of an academic journal, I explored the academic and professional environment of the mid-1970s. In 1975, there were 14 colleges of optometry in the United States and Puerto Rico.[1] Only four states included the use of diagnostic drugs in the scope of optometric practice.[2] In 1974-75, admissions to Optometry College were considered very competitive, with 3,500 applicants competing for 982 available seats. The applicant-to-vacancy rate was 3.6 to 1. The mean grade point average of entering undergraduate students was 3.08 out of a possible 4.00. Females constituted 10% of the enrolled students, and tuition/fees were $2,500 at private institutions and $1,500 at state institutions.[3]

The Evolution of a Profession

It was during this time in the mid-1970s that the profession started to evolve from one whose main focus was refractive, accommodative and binocular conditions to one in which the optometrist was considered a "first contact health professional." [4] As first contact healthcare professionals, or primary healthcare professionals, optometrists took on the responsibilities of early diagnosis of ocular and systemic diseases, especially those that presented with ocular symptoms.[4] They needed to be able to recognize non-optometric health problems and make appropriate and timely referrals. Additionally, optometrists were expected to assume responsibility in the community by providing leadership in health planning, education and administration.[4]

Along with the evolution of the profession, changes occurred in the education and clinical training that facilitated subsequent changes in scope of practice. The evolving scope of practice, and its associated legislative processes, led other professionals (such as physicians and legislators) to look more closely at the education of optometrists. As the education of optometrists came under that critical review, the *Journal of Optometric Education* provided a crucial avenue for disseminating educational information to help faculty members teach students to the highest levels using sound methods and innovative ideas. Additionally, the journal provided a substantial and concrete representation of the quality of optometric education for review by educators as well as other professionals.[4] In 1975, changes in the profession both supported and necessitated the creation of an academic journal.

The Evolution of a Journal

In doing research for this editorial, I reviewed the earlier editions of the journal. Throughout the years, many common themes repeated. Articles on the cost of education, how to best educate our students, and faculty issues such as professional development and tenure were addressed in the '70s as well as in more recent editions. However, I was very struck by the types of articles and how they changed over time. In the early editions of the journal, most of the articles were descriptive or opinion pieces. It was not until the late 1990s that educational research articles started to appear with some frequency. The journal, renamed *Optometric Education* in 1991, still provides a forum for disseminating educational information. Now, however, the emphasis is on educational research as a means of achieving evidence-based teaching and learning. Our educational decisions should be well-grounded in evidence, and the journal should be the means of disseminating that information.

The research into the '70s was both interesting and informative. Those who have contributed to the journal in the past should be commended for their support of optometric education. The previous editors should be praised on their leadership and hard work. The authors who have contributed to the journal have made an impact on the growth and development of both the profession of optometry as well as optometric education. Also, a journal would not have the capacity to influence a profession if it were not for the readers, so a special thanks to our readership, too.

In This Edition of the Journal

This edition highlights several topics. As a tribute to our 36-year history, former editors were asked to comment in the "Think Tank" on their years with the journal and how it has changed.

Also featured is a topic most educators have often debated: how to find the time to properly cover course content. Expansion of scope of practice often leads to an increase in information needed. However, this is usually accompanied by a desire to decrease didactic hours and increase clinical time. Dr. Bill Sleight's paper, "Assessment of the Ocular Disease Diagnostic Tutor as a Learning Tool," investigates the use of technology in helping students learn. His research also provides important insight and raises many questions concerning the best use of instructor/student face-to-face time.

Drs. Tressa Eubank and Jill Pitts document the changes in students' learning styles in their paper, "A Comparison of Learning Styles Across the Decades." It provides interesting information for educators teaching the current generation.

In her paper, "A Backward Glance on Optometric Education: Institutional Profile of Schools and Colleges of Optometry," Dr. Shilpa Register takes a historical look at optometric education, including the development of core competencies, a fitting topic in light of the 36th anniversary of the journal.

Articles concerning the cost of education have been published since the first edition of the journal. Dr. Barbara Brown and colleagues identify ways to minimize student debt in today's environment in their paper, "Best Practices in Debt Management for Optometry Students, A Roadmap from Inquiry to Graduation."

Two papers in this edition specifically address clinical education, another topic that has been consistently represented in the journal over time. Dr. Cheryl Ervin and colleagues provide information about a novel means of providing clinical training in "Private Practice Residency in Vision Therapy and Rehabilitation," and Drs. Len Hua and Lorne Yudcovitch provide educators with an important resource in "Anterior Uveitis: Teaching Case Reports."

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1. Register S. A backward glance on optometric education. Optometric Education. 2011 Winter-Spring ;36(2):76-81.
2. Filer C. Pacific University in profile: generation of leadership. Journal of Optometric Education. 1975 Summer-Fall;1(3):113-16.
3. Gold AR. Optometric education in the seventies. Journal of Optometric Education. 1975 Summer-Fall;1(3):120-23.
4. Baldwin WR. Tomorrow's challenge. Journal of Optometric Education. 1975 Spring;1(2):74-9.

Special Announcement:

ASCO Launches "Starter Grant" Program for Educational Research

The Association of Schools and Colleges of Optometry (ASCO) is pleased to announce the launch of a "starter grant" program dedicated to educational research. Funding from The Vision Care Institute, an affiliate of Johnson & Johnson Vision Care, Inc., will support two starter grants in 2011.

The educational research grants will serve to introduce and support the concept of the Scholarship of Teaching and Learning (SoTL). Although **all types** of educational research projects will be considered for a grant, priority will be given to those that embrace SoTL. SoTL applies to all disciplines and levels of academia. It embraces teaching as a worthy subject for research with the goal of producing a public body of knowledge that is reviewed, developed and tested for the purposes of increasing the effectiveness of teaching and student learning.

Faculty from the 20 ASCO member institutions will be eligible to apply. Grant applications and information will be available by March 15 through the deans, presidents and chief academic officers of the schools and colleges of optometry.

Think Tank ...

Optometric educators, we welcome your comments on ...

"During your years as editor of Optometric Education, *what did you set out to accomplish? What were the significant issues of the time for the profession in general and for optometric educators in particular? What are your thoughts about the journal during your time compared with the journal of today?"*

I had the pleasure of serving as the editor of what was then titled the *Journal of Optometric Education* from the fall issue 1978 until the winter issue 1985.To place this time period in some perspective, the journal published its first issue in 1975, so it was relatively new as a publication. The primary challenge of this time period was ensuring there was a sufficient number of quality manuscripts submitted for review and publication. This required the editor, editorial board members and managing editor to continually be encouraging individuals and, in particular, faculty members to write articles related to optometric education. It should be remembered this was a time when faculty were not necessarily writing articles specifically about optometric education and there were fewer schools and colleges and, of course, faculty than today.

This encompassed a time in which optometric education was beginning to embrace new teaching methodologies, optometric residency programs were still relatively few in number, and some schools and colleges did not have significantly developed externship programs. Similarly, many clinic programs were structured more as teaching laboratories than as self-sufficient entities.

During the past 30 or more years there has been great change in technology available for optometric education and this has greatly impacted all aspects of the optometric enterprise. Even so, a quick review of the journal issues that appeared during my time as editor showed that the publication was addressing some of the same topics that are being addressed today in current issues of the journal and by optometry as a profession.These included such topics as manpower, the need for relevant practice management education and continuing competency. At least two topics have changed significantly from this time period: perceived barriers for women in optometry, and pharmacology training in optometry. In contemporary optometric education there are more women than men students enrolled in schools and colleges, and pharmacology has been inculcated in a meaningful manner into almost every aspect of optometry.

Based on the quality of articles that appear in current issues of *Optometric Education* there is greater interest in sharing ideas and information related to all aspects of optometric education. There have been significant changes in professional program curricula, substantial growth in optometric externship and residency programs as well as continuing education. These changes, together with the increase in optometric education institutions, appear to provide a more abundant source of quality articles.These changes have all contributed to a more vital publication for the profession.

John F. Amos, OD, MS
1978-1985

It seems remarkable to me that we are celebrating 36 years for the journal *Optometric Education*. As I take the long view and look back on the journal's history, many of the challenges have remained the same. I believe that all of us who have served as editor have sought to publish articles that meet the standards of quality research and scholarship, and, indeed, which will have a positive impact on optometric education and ultimately the abilities of our graduates.

As in any scholarly endeavor, the publication of new knowledge that benefits the community is of the highest priority, but, as *Optometric Education* is a very specialized journal, attracting true educational research articles has been and may always be a challenge. Acknowledging this is important as it leads one, as an editor, to embrace the power of the journal to be a thought leader and a bridge to new knowledge, trends and practices from the larger healthcareeducation community.

If I reflect on my own tenure as editor from 1987 to 1991, I believe the true value of the journal was in its power to introduce novel concepts and to articulate emerging challenges to our educational community. During those years, we helped to introduce the schools and colleges of optometry to the challenges of teaching critical reasoning, establishing life-long learning, developing new and more effective clinical assessment tools, and managing a curriculum be-

ing overwhelmed by new knowledge and the expanding scope of optometric practice. Optometry's integration into our healthcare delivery system is accelerating, and *Optometric Education*'s role in stimulating educational innovation and reform is destined to increase.

David A. Heath, OD, EdM
1987-1991

As editor, my most important goal was to strengthen service to the readership by providing opportunities for publication and a forum for relevant issues. I had the opportunity to introduce some new formats for features including "Think Tank" and "My Best Day in Optometric Education," both of which are opinion-based and designed to be provocative, inspirational and diverse in perspective. Working with Dr. Barry Kran from the New England College of Optometry, we were able to introduce the Teaching Case Report format, which was designed to encourage clinical educators to share their expertise, while also providing readers with materials that could be used to enhance their own teaching. I also had the opportunity to work with a number of first-time authors to help them through the review and publication process. What a thrill to see your name in print for the first time!

The biggest change that occurred during my time as editor was not something that I initiated or envisioned. In fact, it was a change about which I was uncertain and hesitant. That was the move away from an in-print format to an online only journal. On the plus side, we are optimistic that the online availability has increased readership access and made the journal available to new audiences. Early tracking of the Web page hits supported the idea that more people were linking into the journal than the previous mailed distribution. Support for the indexing of articles on the Website provided by Transitions Optical has made it even easier to find topics of interest. Hopefully, this has been a positive change in keeping with current trends in technology.

Elizabeth Hoppe, OD, MPH, DrPH
2005-2010

Our focus during my editorship was singular, and that was to develop and enhance the scholarship of the contributions to the publication. We actively recruited submissions and developed theme issues to allow more authors to contribute their work within a framework where their colleagues both assisted and supported good scholarship. And, it worked out really well. Authors who had little experience got to work with more experienced writers, and more experienced contributors had the opportunity to help their colleagues. While that was all good, and it met our goals and objectives for the publication, the most interesting articles we published during my tenure were not scholarly at all. I did a series of interviews with deans and presidents of schools and colleges of optometry, and I found the different personalities to be instructive for educators, as well as interesting studies on how leaders in our profession think. Each person interviewed was forthcoming with insights and perspectives that I found illuminating and humanizing at the same time. I still remember a response Sylvio Dupuis, OD, gave me to a question about the varied aspects of his career. He said that you should contribute as best you were able and when you have done so it is then time to move on. Don't look back. Don't rest on your laurels, but move on to other challenges and opportunities, and you will have a great life. I was really impressed by his comments and have told the story hundreds of times over my life in the profession.

I have tried to live that life as best I have been able because of that insight, and I have had a great life. It pleases me greatly to say that the journal is much better today than when I was the editor, which is as it should be. The articles are more scholarly and more varied in their subject matter, and it makes me especially proud to have been a small part of the publication.

John W. Potter, OD, MA
1985-1987

During my term as editor, 1999-2002, my emphasis was on promoting the validity of academic publications in the area of educational process and teaching methodologies. My premise was that we needed quality publications by and for professional optometric educators to advance teaching and learning. We also needed recognition that these types of papers were indeed a form of scholarship that mattered. My "gold standard" for papers on professional education was the journal *Academic Medicine*, and I wanted our journal to be of the same caliber. I felt that optometry's education journal should be the "go-to" place for professional educators to seek knowledge and information, and with a lot of work we could get there.

In my opinion, the recognition of work efforts of teachers, and the translation of their work into various forms of scholarship, is critical to an institution's success. This is particularly true for faculty who choose a clinical career. So with the journal my constant worry was grounded in the reality that when I attempted to solicit papers from thought leaders in optometric education there was a resounding pushback that their work did not "count" toward promotion and tenure, especially if it were published in this journal. So my first effort was to restructure the editorial review board and bring rigor to the peer review process by adopting and applying the dreaded "S" word, STANDARDS. Then I hit the road with bragging rights about the blue ribbon panel of experts who then comprised the review board.

Next I undertook a review of the accreditation standards for optometric institutions. I found that the Accreditation Council on Optometric Education (ACOE) standard on research did not appear to encourage scholarship in education and teaching. I say this because it was vague and not substantive.While this standard is deliberately written to be broadly interpreted, the perception of many faculty leaders and institutional leaders in optometry was (and I feel still is) that the research standard favors original discovery rather than all forms of scholarship, including the scholarship of teaching, reporting of educational methods, and the outcomes of

applying certain teaching strategies.

I recall writing a letter to ACOE leadership to that effect, expressing my concerns that the scholarship of the profession would suffer if the work of our teaching colleagues was not clearly outlined as important. I urged ACOE to encourage institutions to support faculty in this area by modifying the standard to include commentary about educational research. By supporting this form of research the ACOE would be providing the institutions with a framework to support their teaching faculty and also provide evidence that this accreditation standard was being met. I felt then and still feel today that the solution to gaining appropriate recognition for teacher-clinician scholars is to change the standard, and prominently name research in education and teaching as an institutional requirement in the accrediting process.

Roger Wilson, OD, FAAO
1999-2002

Send Us Your Comments

Do you have any thoughts or insights related to the journal Optometric Education *over the years? Send your comments to Dr. Aurora Denial at deniala@neco.edu, and we will publish them in a future edition of the journal.*

Invitation to Participate
Upcoming Theme Edition

Scholarship

Scholarly contributions by faculty are a critical component of faculty development, promotion/tenure and delivery of optometric education. Most optometric faculty have minimal formal training in professional writing, research and publication. Scholarly contributions move education forward and can significantly impact the profession. *Optometric Education* is announcing a future theme edition, which will focus on scholarship. The theme edition is scheduled for publication in 2012. We are sending out this invitation early to allow for adequate time to design appropriate studies. **We invite all educators and administrators to participate in this theme edition.**

For additional information on theme editions, contact Dr. Aurora Denial, deniala@neco.edu.

Optometry: There's an App for That!

Geoffrey Goodfellow, OD, FAAO
Dominick M. Maino, OD, MEd, FAAO, FCOVD-A

Recently, our colleague Dr. Leonard Press published a brief article on how using a cell phone saved his 5-year-old granddaughter's eye from the potentially devastating effects of cellulitis.[1] This story really started when Dr. Press' daughter sent him a photograph of his granddaughter's eye via her cell phone. The digitally transmitted photograph showed an eye that was typical of a severe periorbital cellulitis.

Dr. Press wrote that as he monitored the well-being of his granddaughter in the hospital, "Her uncle Dan—who is also my son and a wonderful associate—helped us improvise a bedside test. He pulled out his iPhone and downloaded a series of Ishihara plates that established that her color vision was normal, indicating healthy optic nerve function." Dr. Press also used a low-tech device to assess visual acuity by turning some Cheerios left over from breakfast into a makeshift Landolt C test. At the end of the story, he noted, ". . . my granddaughter and I will look back fondly upon I.V. antibiotics and cellular phone medicine."

This story demonstrates the incredible potential of the power of technology that is instantly available, relatively inexpensive and already in the possession of many of our optometric colleagues and students. Let's take a look at the different platforms and the "apps" (short for software applications) suitable for use by optometrists.

iPhone

Apple's iPhone was a major success even before its initial release. The original 2G iPhone was made available on June 29, 2007, and the 3G version was released about a year later. The iPhone 4 made its first appearance in June 2010. The original iPhone established a design that has been maintained by all the updates. The later incarnations added a 3G cellular network and GPS location capabilities, a compass, faster processing speed and a higher resolution camera for photography and videography. The latest model has two cameras for video calling and an even higher-resolution display. This is an incredible amount of technology in a very small package. And even more incredible, it works pretty much as promised.

iPad

When the iPad was released in April 2010, Apple sold 3 million devices in only 80 days. More than 4 million iPads were sold worldwide by the second quarter of that year. This device is larger than the iPhone and has a 9.7-inch (measured diagonally) display area. Connectivity is provided by using 3G, WiFi and Bluetooth technology as well as a proprietary docking device. Many, but not all, of the iPhone apps will also run on the iPad. There are also several programs specifically designed for the features that the iPad offers. This and other tablet-type devices are also catching the fancy of electronic health record users. If you think switching from paper to a desktop PC was transformative, imagine holding an iPad like a clipboard and entering chart information in real time at chairside.

Other Platforms

Other smart devices now have apps that run on the Android software system. Android is a mobile software operating system from Google. Google has an online store where these various applications can be downloaded. The Android OS is currently used as an operating system for cellphones, netbooks and tablet personal computers. Because it is a newer operating system, there are fewer apps available for Android, but the list is growing daily. Several medically oriented apps are already available.[2] Windows 7 is the newest platform to enter the mobile phone realm, and developers are starting to produce apps for these devices as well.

Optometry: There's an App for That!

Just what software applications are available for us to use for education and clinical care? There are probably hun-

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dreds to choose from depending upon your device and software platform. For this article, we will mostly discuss those apps available for the iPhone. These apps can be found on the Apple Store Website and are often free or available for a minimal cost. We use the following apps on the iPhone almost daily.

Epocrates. We've used Epocrates for several years, first on a Treo Palm device and now on iPhone. (Figure 1) The makers of Epocrates report that using this app helps doctors avoid making medical errors and saves them 20 minutes or more a day. The free app provides clinical information on prescription and OTC medicines, formulary information, a pill identifier and a drug interaction checker. It also performs various calculations and provides the latest medical news and information. The premium version of Epocrates also lists the latest evidence-based treatments, treatment guidelines, lab prep, interpretation and follow-up for hundreds of tests and panels, a medical dictionary and ICD-9/CPT(R) codes. (www.epocrates.com)

MedScape. Although we use Epocrates often, more and more frequently, I (DM) have been turning to MedScape for answers I need quickly. (Figure 2) It offers many of the same information that Epocrates does, but I seem to be able to get to it quicker. It has a drug database that gives adult and pediatric dosing, adverse effects, contraindications, cautions and warnings and pregnancy and lactation guidelines. It also checks interactions of drugs with herbals and supplements. MedScape is available for the iPhone, iPad, BlackBerry and Android-based phones. (www.medscape.com)

The Eye Handbook. The Eye Handbook was created by doctors for doctors. (Figure 3) Its many resources include a duochrome test, eye diagram, eye atlas, EyeWiki,treatment and vision symptoms. You can also find information about coding/billing and download lectures and videos and more. You can download content from optometric journals, including the AOA's Optometryand the OEPF's Journal of Behavioral Optometry. Medications are listed alphabetically, and plenty of pictures and explanations of various eye problems are available for helping patients understand your findings and recommendations. It is practically an all-in-one app. (https://sites.google.com/a/cloudninedevelopment.com/index/product-page/eye-handbook)

EyeXam. This app provides tools to assess visual acuity, color vision, astigmatism, macular integrity, near point of convergence and more. It also uses AllAboutVision.com to help answer questions that the patient may have. (http://itunes.apple.com/us/app/eye-xam/id357290178?mt=8)

EyeChart. This app does what you would expect by offering a Snellen eye chart for the patient to read from

Figure 1
The Epocrates app provides clinical information on prescription and OTC medicines, formulary information, a pill identifier and a drug interaction checker.

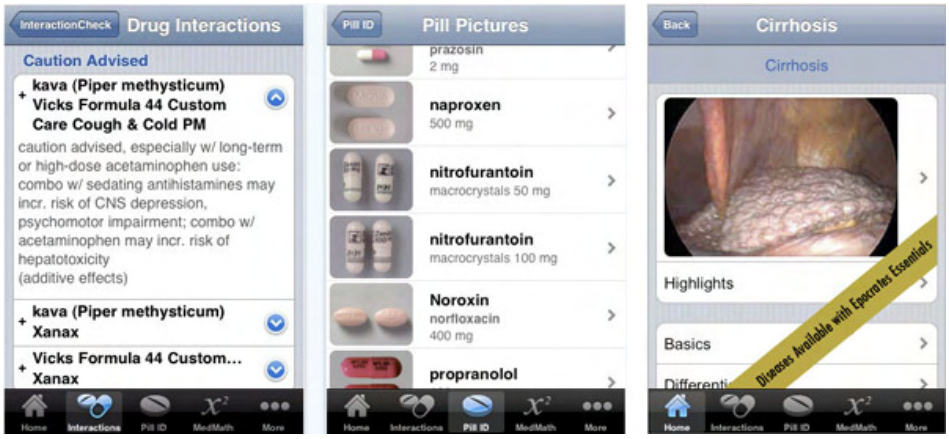


Figure 2
The MedScape app is available for the iPhone, iPad, BlackBerry and Android-based phones.

Figure 3
With its wealth of resources and tools, The Eye Handbook app is practically an all-in-one app.

a certain distance. Eye Chart lets you tap on a line to change the optotypes if needed. (http://itunes.apple.com/us/app/eyechart/id293163439?mt=8)

EyeDock. The EyeDock app was created by Dr. ToddZarwell, an ICO graduate. (Figure 4) It offers contact lens and medication information, diagnostic codes and patient information tools. The contact lens database allows you to find information about the manufacturers, lens parameters, manufacturing processes and more. There are numerous tools and calculators that help with everything from conducting the Parks 3-Step Test to converting various measurements. This is a subscription-based app that costs $43 per year. (http://www.eyedock.com/index.htm)

Of the apps listed above, we use MedScape, Eye Handbook and EyeDock most of the time. Although we'd give most of these apps at least four stars, additional user reviews can be found at the iTunes Store.

Other Apps of Interest

These are some additional apps we think are worth checking out.

The Skeletal System Pro. This app can zoom in and identify any region, bone, bone part or ligament and rotate for a wide variety of views. It contains more than 350 images. A self-test is available as well. (http://www.3d4medical.com/Skeletal-System-application_APP1.html)

Anatomy on the Go. Illustrations from Thieme's complete Atlas of Anatomy are customizable and interactive. (http://modality.com/apps/Anatomy-on-the-Go_p_246.html)

Medical Abbreviations. More than 13,000 are available. (http://doctorcalc.com/medical-abbreviations)

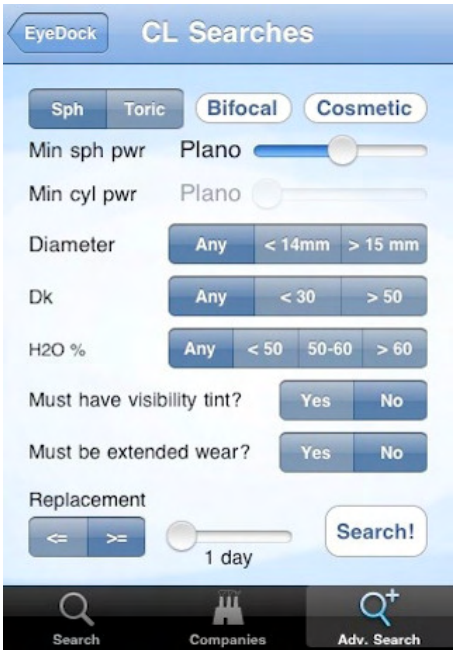
Brenner: Pharmacology Flash Cards. This app lists the drug name, pronunciation, trade name, therapeutic class, pharmacologic class, mechanism of action, clinical use, special considerations, adverse effects, interactions and similar drugs. (http://modality.com/apps/Brenner-Pharmacology-Flash-Cards_p_76.html)

Patient Tracker. This app stores the history and physical and notes for your patients. Although it is meant to be used in a hospital setting, it may be also be useful for optometry students. (http://doctorcalc.com/patient-tracker)

Glasgow Coma Scale. This app facilitates documentation of eye opening, verbal responses and motor responses of patients with head injury. (http://www.handheldcare.com/HandheldCare/Glasgow_CS.html)

ICD9 Consult. This makes the ICD9-CM available on your iPhone. (http://www.icd9consult.com/ICD9_Consult.html)

Figure 4
The EyeDock app offers a contact lens database, medication information, diagnostic codes, patient information resources and numerous tools and calculators.



Boost Your App-titude

I (DM) will tell you that some applications can have strange and interesting results. For instance, when I said "esotropia" to the Dragon Medical Search voice-recognition app, it tried to search on "He is so tropia"! Of course that wasn't quite what I wanted.

Clearly these small electronic devices will continue to change the way we do business as clinicians and educators. You just never know what helpful resources will pop up next. Since our patients in the exam chair are wielding the latest and greatest gadgets, they are also expecting their doctors to be up to date with tools to make the optometric patient experience better.

The best way to learn more about these tools is to simply jump in. With a new tablet or smart cell phone in hand, you can start to explore the various apps available on your chosen platform.

Have you fallen in love with an optometric app that we've neglected to mention? We would love to hear about it at dmaino@ico.edu and ggoodfel@ico.edu.

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Assessment of the Ocular Disease Diagnostic Tutor as a Learning Tool

William E. Sleight, OD

Abstract

The Ocular Disease Diagnostic Tutor (ODDT) is a computer-based training (CBT) application that emphasizes the recognition and diagnosis of ocular disease. The ODDT is self-paced and deploys a decision-based approach to learning. In this study, the ODDT was used as a supplement to traditional classroom teaching. A randomized study was designed to evaluate whether or not use of the ODDT would improve student performance in the description, diagnosis and management of ocular disease. The evaluation demonstrated that the ODDT user group achieved an average of one standard deviation improvement in performance over tested material.

Key Words: *computer-based training, ocular disease, diagnosis, interactive, decision-based learning*

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Statistical analysis by Thomas G. Travison, PhD, Research Assistant Professor of Medicine and Biostatistics, Boston University

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Background

Over the past 20 years, the increase in scope of optometric practice has necessitated optometric clinicians to have a deep understanding of ocular disease. This, coupled with an explosion of medical knowledge, has led to a number of challenges within the optometric curriculum. The crowding of the curriculum makes it difficult to address the multitude of diseases that practicing clinicians are responsible for understanding. Additionally, optometric education is responsible for exposing students to less common, but sight-threatening ocular diseases. Although clinical experience is a key component to the understanding of disease, it is not possible for every clinician to experience the analytical process of differentiating between seldom-seen clinical entities. Clinical reasoning skills and critical observational skills are essential abilities in the practice of optometry, yet it is difficult to correctly diagnose and manage conditions that are rare or possibly encountered on a first-time basis. The Ocular Disease Diagnostic Tutor (ODDT) was developed to address these challenges in teaching ocular disease.

The ODDT is a computer-based training (CBT) application built on the premise that "decision-based learning" leads to better knowledge retention than passive text and graphic presentations.[1] The ODDT provides clinical challenges in a highly interactive, decision-based format. There are several ODDT modules covering retina, cornea, macular dystrophies and uveitis.

The program trains the ability to describe detailed clinical attributes of various ocular diseases. A major premise of the ODDT is that once the trainee can accurately identify specific pathologic attributes, the trainee can apply this knowledge to correctly diagnosing a particular ocular disease. In optometry, diagnosis of ocular conditions is highly dependent on visual analysis, and less dependent on laboratory findings. Therefore, it is essential that ocular disease attributes are correctly identified in a meaningful way so as to facilitate the pathway to a correct diagnosis.

The ODDT presents five major interactive screen interfaces. Four of the exercises are scored and recorded (# 2-5 in the list below). The major activities are:

1. Topic files: Text and graphic files with image interactions. The topic files provide background knowledge necessary for quiz and case questions. Additionally, these files are rich with images and unscored quiz questions.
2. Nomenclature exercises: A series of paired recognition exercises designed to introduce clinical-pathologic terminology.
3. Diagnostic cases: A series of 10-20 interactive exercises, which involve recollection and application of clinical terms, differential diagnosis and encyclopedic knowledge.
4. Reasoning cases: Another series of 8-10 interactive exercises that require students to analyze a case history, formulate a field of several diagnostic possibilities, identify and comment on pertinent case information, formulate a problem/plan list, read the case analysis and submit a self-assessment.
5. Interactive quizzes: These are scored computer-based quizzes with multiple choice questions, matching questions, fill in the blank, drag and drop, and hot spot interactions.

Progression through the program is based on problem-solving rather than reading and memorization. The exercises in the ODDT are increasingly complex and were developed in accordance with the Trivium classical academic approach of teaching (recognition, followed by recollection, followed by reasoning).[2]

Students monitor their progress via a screen that tracks their activities and marks each exercise as incomplete, complete or complete with extra credit. Students earn extra credit by scoring 80% or better on the first attempt. This is easy to do as the program allows them to look up the answers in the topic files while they are still in a quiz or case interaction. The extra credit mark provides an incentive for not arbitrarily selecting choices until the correct answer is found by process of elimination.

This study was designed to test the hypothesis that the ODDT improves performance in the areas of clinical description, diagnosis and treatment of ocular disease.

Methods

Sixty-nine students at the New England College of Optometry (NECO) participated in the study. All students were given a pre-test prior to entering their fourth-year clinical rotations. The exam was administered in five sections. Results were recorded on separate data sheets for each section. In section 1, students were given an 8x11 in. montage displaying four images. Students were asked to describe each of the four images in a clinically meaningful way. In section 2, students were asked to match pre-defined terms to the same set of images. In section 3, students were asked to list several conditions that should be considered in the differential diagnosis. In section 4, students were asked to analyze a correlating case history and then form a diagnosis and corresponding problem/plan. In section 5, students took a true/false factual knowledge test. The exam parts were given out and taken back in sequential order so as to prevent students from changing previous answers once more information was provided later in the test.

The ODDT program was given to fourth-year optometry students at four different Neighborhood Health Centers (NHC) in the greater Boston area. Students in their fourth-year are required to rotate to new clinic sites every three months. Data collection points occurred during summer, fall, winter and spring rotations. Each student was assigned to an NHC via a lottery, thus achieving randomization. During any given quarter, two sites were user groups and two sites were controls. The user sites were switched in order to avoid a site bias. In total, 38 students used the program and 31 students served as controls. At the conclusion of the study, both groups of students were given a post-test identical in format to the pre-test. The content of the post-test was necessarily different from the content of the pre-test. Students were notified about confidentiality and study protocols so as not to contaminate user and control populations. Two students were given clinical assignments that resulted in overlap between user and control populations. These students were not included in the statistical analysis.

All pre-tests and post-tests were graded in a blind fashion by an independent contractor. A precise scoring rubric was developed for scoring the examinations. The scoring rubric was applied to all pre-tests and post-tests. The tests were masked such that the grader did not know if a particular test was from a user or control study group. The user and control groups were balanced in terms of the quarter in which the post-tests were administered. In other words, there were approximately the same number of users and controls during each quarter to eliminate a learning bias.

Table 1.1
Group assignment (number of subjects), by semester

Group Assignment	Semester			
	1	2	3	4
Control	5	11	8	7
User	11	7	10	10

Table 1.2
Percent improvement, by section and assignment group

	Control		User	
	Mean	SD	Mean	SD
Section 1	1.163	16.192	13.1579	14.533
Section 2	-0.221	0.232	-0.0968	0.182
Section 3	-0.275	0.199	-0.1690	0.173
Section 4	-13.262	15.054	2.0671	20.294
Section 5	-0.907	10.771	2.7138	13.654
Overall	-9.693	10.415	2.1443	11.540

Table 1.3
Summary difference between groups, controlling for semester

	Mean	SE	p-val	95% CI	Eff. Size
Section 1	12.541	3.620	0.001	(5.45, 19.64)	0.77
Section 2	0.138	0.050	0.007	(0.04,0.24)	0.65
Section 3	0.112	0.046	0.017	(0.02,0.20)	0.59
Section 4	15.948	4.473	0.001	(7.18, 24.72	0.81
Section 5	4.173	3.140	0.189	(-1.98,10.33)	0.33
Overall	12.630	2.607	0.000	(7.52, 17.74)	1.01

Results

The results of the evaluation of pre-test and post-test scores showed a statistically significant difference between users and controls across sections 1-4, but not part 5. The greatest disparity between the user and control groups was seen in sections 1 and 4.

Section 1 measured the ability of students to correctly describe pathologic attributes of an image without any prompts. The mean score for the control group was 1.16 with a SD of 16.19, and the mean score for the user group was 13.16 with a SD of 14.53 (Table 1.2). The mean difference between users and controls was 12.54 at p-value 0.001 with an effect size of 0.77. Users could be expected to outperform controls between 5.45 and 19.64 points at a 95% level of confidence (Table 1.3).

Section 2 measured the ability of students to correctly describe pathologic attributes of an image when a list of terms was provided. In section 2, the mean score for the control group was -0.22 with a SD of 0.23, and the mean score for the user group was -0.10 with a SD of 0.18 (Table 1.2). The mean difference between users and controls was 0.14 at p-value 0.007 with an effect size of 0.65. Users could be expected to outperform controls between 0.04 and 0.24 points at a 95% level of confidence (Table 1.3). Although these results were statistically significant, the effect size was not clinically relevant. When given a list of terms, the user and control populations performed similarly.

Section 3 measured the ability of students to define a field of conditions that the photos could reasonably represent. In section 3, the mean score for the control group was -0.28 with a SD of 0.2, and the mean score for the user group was -0.17 with a SD of 0.17 (Table 1.2). The mean difference between users and controls was 0.11 at p-value 0.001 with an effect size of 0.59. Users could be expected to outperform controls between 0.02 and 0.20 points at a 95% level of confidence (Table 1.3). As with section 2, these results were statistically significant, but the effect size was not clinically relevant. Thus both user and control groups were able to generate a list of conditions that should be included in the differential diagnosis.

Section 4 measured the ability of students to correctly diagnose the particular condition and form an appropriate problem/plan list once the case history information was provided. In section 4, the mean score for the control group was -13.26 with a SD of 15.05, and the mean score for the user group was 2.07 with a SD of 20.29 (Table 1.2). The mean difference between users and controls was 15.95 at p-value 0.001 with an effect size of 0.81. After using the ODDT students could be expected to outperform controls between 7.18 and 24.72 points at a 95% level of confidence (Table 1.3). As with section 1, these results were statistically significant and clinically relevant.

Section 5 measured the ability of students to retain straight factual knowledge over the testing period. This was assessed by means of 32 true/false questions about various conditions. In section 5, the mean score for the control group was -0.90 with a SD of 10.77, and the mean score for the user group was 2.71 with a SD of 1365 (Table 1.2). The mean difference between users and controls was 4.17 at p-value 0.1.89 with an effect size of 0.81. After using the ODDT students could be expected to outperform controls between -1.98 and 10.33 points at a 95% level of confidence (Table 1.3). The p-values, the large SD relative to the mean, and the low effect size indicate that there was no significant difference between the users and controls when it came down to retaining factual knowledge.

Discussion

The study hypothesis was that using the ODDT improves performance in the area of clinical description, diagnosis and treatment of ocular disease. The ODDT was designed to be engaging and interactive. The interactions were constructed to bring students to the point of making a decision about a slide or case scenario, and reinforced by requiring students to type in their answers.

Sections 1 and 4 demonstrated clinically relevant differences in performance between user and control populations.

Section 1 assessed the ability to correctly describe clinical attributes of a fundus picture without making false observations. Section 4 assessed the ability to arrive at a correct diagnosis and create a suitable problem/plan. In order to be clinically relevant, it is desirable to demonstrate an effect size of 0.8 or higher.[3] The effect size for section 1 was 0.77 (p-val 0.001) and the effect size for section 4 was 0.81 (p-val 0.001). In a study of this nature, there are multiple variables at play and demonstrating high effect sizes is difficult. However, we were very pleased that using the ODDT did result in significant performance differences between the user and control populations in these sections. The ability to correctly describe various ocular pathologies without making descriptive errors is a vitally important clinical skill. Correct observational skills play an important role in making the correct diagnosis. Furthermore, the ability to diagnose conditions and formulate appropriate plans is essential for appropriate patient care.

Sections 2 and 3 did not show clinically relevant differences between user and control groups though the results were statistically significant. Section 2 measured the ability of students to correctly match clinicopathologic terms to a picture, and section 3 measured the ability to form a list of conditions that comprise the differential diagnosis of a particular condition based solely upon the clinical appearance. These results were not surprising. We would expect that students in their fourth year should be able to recognize and apply the correct terminology to characterize pathologic changes to tissue, even though they may not be able to recall the terms as in section 1. Because students were matching terms from a list, there is less likelihood of describing an image incorrectly. With regard to section 3, which measured the ability to generate 2-3 reasonable conditions in the differential diagnosis, the difference between the user and control groups was not clinically relevant. Again, this was not unexpected as we would expect fourth-year clinicians to be able to come up with a list of conditions with or without exposure to the ODDT program.

The results from the analysis of section 5 were unexpected. The ODDT did not improve the factual knowledge retention of students. The measure was a straightforward true/false test. The effect size was 0.33 (p-val 0.189). This was the perhaps the most interesting result of the study. Throughout the diagnostic cases and quizzes, there were numerous questions including matching, fill in the blanks, drag and drop, multiple choice and multiple response. Students were required to answer all the questions at an 80% level in order to complete the program requirements. However, after completing the ODDT curriculum, users did not do much better than the control group in a straightforward true/false factual recognition exercise. As a result of this finding, future modules in the ODDT will emphasize exercises that incorporate observational skills and diagnostic thinking as opposed to exercises that deal with factual knowledge.

Summary

When combining the data for all sections, the mean score for the control group was -9.7 with a SD of 10.4, and the mean score for the user group was 2.1 with a SD of 11.5 (Table 1.2). The mean difference between users and controls was 12.63 at p-value 0.001 with an overall effect size of 1.01. After using the ODDT, students could be expected to outperform controls between 7.5 and 17.7 points at a 95% level of confidence (Table 1.3). Thus using the ODDT improved overall performance by 1.01 SD.

In Table 1.2, there are numerous negative test scores. This is an artifact of the grading rubric. In both the pre-test and the post-test, points were awarded for correct observations and deducted for incorrect observations. The pre-test contained images of conditions, which were less feature-rich than the images used in the post-test. The increase in complexity of the post-test resulted in the potential for more incorrect observations and grade-point deductions. Therefore, it was possible for students to do worse on the post-test than on the pre-test. This proved to be the case.

The standard deviations depicted in Table 1.2 are large relative to the mean. This likely occurred due to wide differences in performance by students in both the user and control populations. One possible reason for disparity in performance may be due to the earnestness of students taking the pre-test and post-test examinations where some students took the exam seriously and others did not. Another possibility is that there is a true disparity with regard to the ability to describe, diagnose and manage ocular disease in fourth-year students. A subanalysis revealed that there was less disparity between the user and control populations in students who were in their fourth clinical rotation than students who were in their first clinical rotation.

Weaknesses and Strengths

The strength of this study is that the ODDT demonstrated a large overall effect size. More importantly, the strongest gains were in the critical tasks of describing clinicopathologic attributes, making the correct diagnosis and formulating an appropriate problem/plan. Effect size is basically the difference in mean values between two or more groups (usually treatment and control), expressed in standard deviation units. The measure of effect size is a useful statistical tool as it allows statistical analysis between two populations that is independent of sample size and the units of measure. Effect sizes may range from negative to positive infinity, but in clinical research effect size rarely exceeds positive 1.0. Cohen assigned relative values to effect sizes as 0.2 = small, 0.5 = medium, 0.8 = large. (3) To achieve an effect size of 0.8 is a significant challenge. Albanese has pointed out that in order to reach a large effect size, some students would be required to move from the bottom quartile to the top 50th percentile or, as another example, some students in the 50th percentile would be required to move the 84th percentile. Albanese comments that over half of the studies in educational and psychological literature would not meet the criteria for a large effect size.[4]

The weaknesses of this study are weaknesses that are inherent in most education research trials. First, it is difficult to isolate a cause and effect relationship between the ODDT user group and the control group. In order to do this, all the ODDT group students would have to use the program in the same

environment and in the same way. This clearly did not happen as some students completed the program over the course of a few days while other students took several weeks to complete the program. Second, it is impossible to control for a myriad of complex and multifactorial variables in real-time environments. Over the nine-month course of the study, some students would have been placed in clinical rotations where there was more ocular disease exposure than in others. Third, some students may have taken the program participation more seriously than others as completing the program was not part of their grade structure. However, it should be noted that only two students assigned to the user group did not complete the study requirements. One of the two incompletes lost the data due an unrelated computer problem.

Comment: Teaching Facts vs. Reasoning

The results of the study indicate that the ODDT was effective in improving the ability of students to correctly describe, diagnose and manage a range of ocular diseases. However, when students were given a true/false test covering factual knowledge, the ODDT was not effective at improving student performance. From an educational perspective this was perhaps the most important discovery of the study. The ODDT presented many quizzes and follow-up questions in the diagnostic cases, both of which were designed to increase factual knowledge. Students were required to answer these fact-based questions correctly in order to complete the ODDT curriculum. The results of this study indicate that students do not retain these factoids very well or for very long. This study raises the age old conundrum: If students do not retain factual knowledge very well or for very long, then should optometric curriculums emphasize teaching and testing factoids? It appears that students may learn and retain the factual knowledge long enough to pass a test, but over time most of that factual knowledge will be forgotten unless it is used frequently.

The question arises as to what is the best use of the face-to-face time instructors have with their students? Should educators plow through disease after disease, presenting all the relevant facts in the traditional fashion of demographics, risk factors, physical exam, pathogenesis, diagnoses and treatment? Surely, it is important that students know this information. Or should educators spend classroom time on training behavioral abilities such as accurately describing the physical findings and making decisions based on the information available? When there is insufficient information, what is the most expedient way to obtain the necessary information that leads to a decision? Do interactive classroom methodologies work better than passive lectures? One study comparing voting machines (clickers) to traditional lecture-based delivery found that voting machines resulted in a significant gain in conceptual learning.[5]

What about testing? At NECO, we have observed that the nature of the test determines how students will prepare for the test. If testing is designed to assess detailed knowledge, students will spend their preparation time memorizing details. On the other hand, if testing emphasizes case interpretation and differential diagnosis, students will spend time analyzing photos and synthesizing paradigms, which helps them to distinguish one condition from another. In doing this, students will learn which facts are necessary for them to know in order to arrive at the correct diagnosis.

What about teaching paradigms? Is one approach superior to the other? Do some students learn better under one model than the other? This study was not designed to compare the ODDT in a head to head fashion with traditional lecture. Rather, this study was designed to demonstrate that students using the ODDT would measurably benefit from doing so. We plan to compare the effectiveness of the ODDT and other CBT applications to traditional lecture in the future.

Conclusion

The ODDT proved to be effective in enhancing performance with regard to its curriculum. Users out-performed controls in their ability to analyze an image, interpret case history and additional examination data, as well as form an appropriate problem/plan list. The ODDT can be used in a variety of settings and locations providing anytime/anywhere access to advanced training in ocular disease. The ODDT has become a permanent and important component to the educational landscape at NECO.

Future Studies

We propose to analyze the effectiveness of a traditional lecture-based learning sequence vs. the effectiveness of an interactive instructional design sequence dealing with ocular disease. Students will have access to the same notes and online lecture materials in both tracks. The traditional lecture track will proceed in the typically expository fashion, while the interactive sequence will use classroom time for the presentation and analysis of cases using a variety of interactive methodologies, including voting machines and team-based learning constructs. In the interactive sequence, the ODDT tool will be used by students outside of class time in order to cover a substantial amount of traditionally taught material. The traditional lecture track will meet twice per week and the interactive sequence will meet once per week. Students will be pre- and post-tested. Performance in clinic and on national board exams will be monitored. We will seek funding to establish new evaluation protocols and analysis.

References

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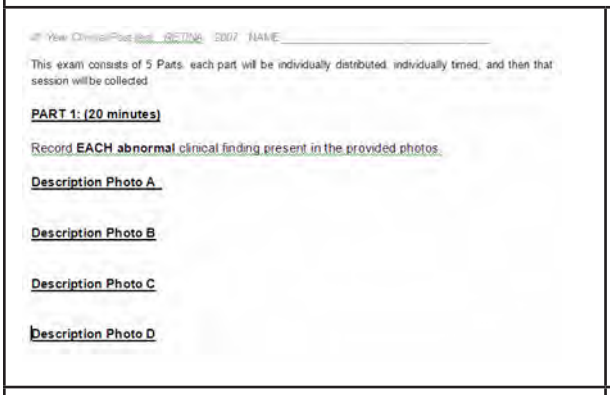
Appendix 1
Example of Pre-test Post-test Format

The Table below shows sample questions from the post-test. The pre-test was essentially similar but the cases and photos were different. The control group and the user group were scored in a blind fashion. The statistical analysis was designed to look for differences between the control group and the user group from baseline. For example, the mean baseline score of the control group may have been 10 points and the mean base line score of the user group may have been 11 points. We expected that the user group as a whole would show a greater delta in score improvement than the control group. In this example, the control group may have improved to 15 points during the test period as they continued their studies and saw more patients. In comparison, the control group may have improved to 20 points. Thus the control group would show a 5-point gain and the user group would show a 9-point gain, with the delta of improvement being 4 points. These figures are for example only. Appendix 2 shows the scoring grid.



4th Year Clinical Post-test RETINA 2007 NAME_____

This exam consists of 5 Parts, each part will be individually distributed, individually timed, and then that session will be collected.

PART 1: (20 minutes)

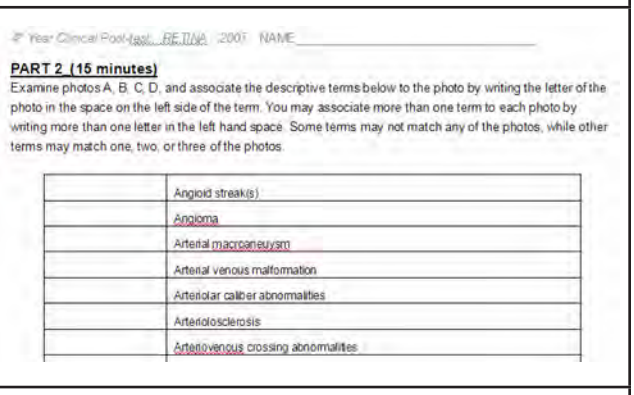
Record **EACH abnormal** clinical finding present in the provided photos.

Description Photo A

Description Photo B

Description Photo C

Description Photo D

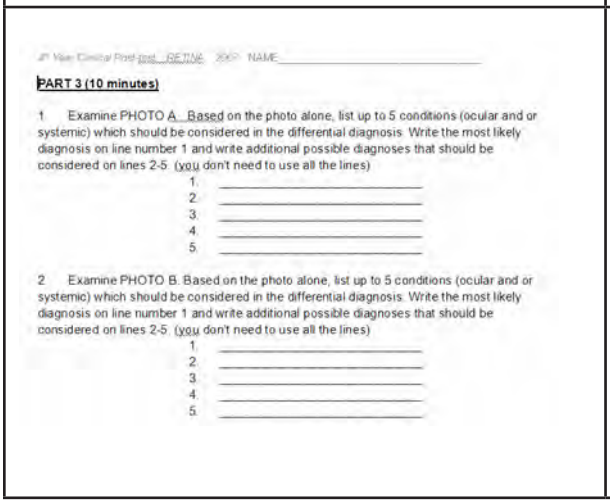


4th Year Clinical Post-test RETINA 2007 NAME_____

PART 2 (15 minutes)

Examine photos A, B, C, D, and associate the descriptive terms below to the photo by writing the letter of the photo in the space on the left side of the term. You may associate more than one term to each photo by writing more than one letter in the left hand space. Some terms may not match any of the photos, while other terms may match one, two, or three of the photos.

	Angioid streak(s)
	Angioma
	Arterial macroaneuysm
	Arterial venous malformation
	Arteriolar caliber abnormalities
	Arteriolosclerosis
	Arteriovenous crossing abnormalities



4th Year Clinical Post-test RETINA 2007 NAME_____

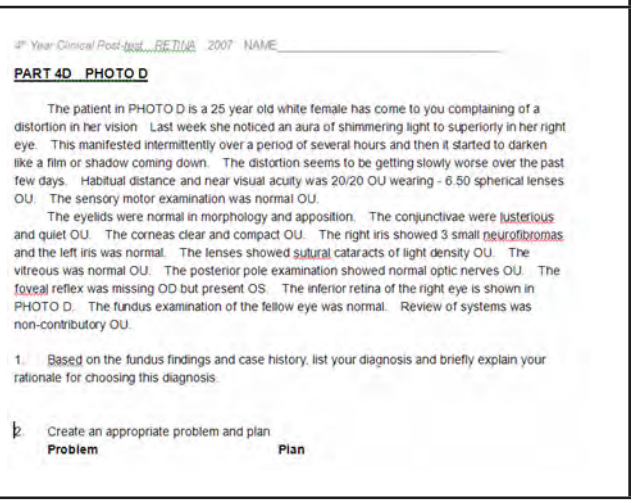
PART 3 (10 minutes)

1. Examine PHOTO A. Based on the photo alone, list up to 5 conditions (ocular and or systemic) which should be considered in the differential diagnosis. Write the most likely diagnosis on line number 1 and write additional possible diagnoses that should be considered on lines 2-5. (you don't need to use all the lines)

1. _____
2. _____
3. _____
4. _____
5. _____

2. Examine PHOTO B. Based on the photo alone, list up to 5 conditions (ocular and or systemic) which should be considered in the differential diagnosis. Write the most likely diagnosis on line number 1 and write additional possible diagnoses that should be considered on lines 2-5. (you don't need to use all the lines)

1. _____
2. _____
3. _____
4. _____
5. _____



4th Year Clinical Post-test RETINA 2007 NAME_____

PART 4D PHOTO D

The patient in PHOTO D is a 25 year old white female has come to you complaining of a distortion in her vision. Last week she noticed an aura of shimmering light to superiorly in her right eye. This manifested intermittently over a period of several hours and then it started to darken like a film or shadow coming down. The distortion seems to be getting slowly worse over the past few days. Habitual distance and near visual acuity was 20/20 OU wearing - 6.50 spherical lenses OU. The sensory motor examination was normal OU.

The eyelids were normal in morphology and apposition. The conjunctivae were lusterious and quiet OU. The corneas clear and compact OU. The right iris showed 3 small neurofibromas and the left iris was normal. The lenses showed sutural cataracts of light density OU. The vitreous was normal OU. The posterior pole examination showed normal optic nerves OU. The foveal reflex was missing OD but present OS. The inferior retina of the right eye is shown in PHOTO D. The fundus examination of the fellow eye was normal. Review of systems was non-contributory OU.

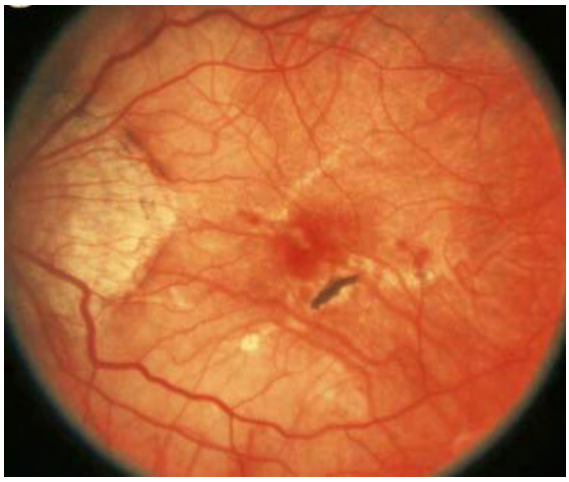
1. Based on the fundus findings and case history, list your diagnosis and briefly explain your rationale for choosing this diagnosis.

2. Create an appropriate problem and plan

Problem **Plan**

Appendix 2
Example of Grading Key Fourth-Year Clinical Post-test 2007

Record each abnormal clinical finding present in the provided photos.



Part 1 PHOTO A 7 Key findings (+1 for each)

KEY FINDINGS

1. Degenerative myopia
2. Diffuse chorioretinal atrophy
3. Lacquer cracks
4. Macula heme
5. PPA
6. RPE hypertrophy and mottling
7. tesselated fundus

Alternate descriptions given by students that were accepted

Albino fundus +1

Area of atrophy near the optic nerve head +1/2

Choroidal scar +1

CNVM +1/2

Fuch spot +1

High myopic retina +1.

Intraretinal hem+1

Macula scar +1

Myopic crescent +1

Subretinal Heme +1

Venous tortuosity +1/2 dilated veins+1/2

Description with no points no deductions

Staphyloma,

Drusen

Hypoperfused retina,

Macula degeneration,

Macula edema

Macula thickening

One point deduction for description given which were inaccurate

-1 angoid streaks

-1 amelanotic growth

-1 artery occlusion

-1 blurred disc margins

-1 cherry red spot

-1 coloboma

-1CSME

-1CWS

-1 exudate

-1 flame

-1 diffuse exudates

-1 feeder vessel

-1indistinct disc margins

-1 NVE--1 NVD

-1 ONH edema

-1 papilledema

-1 Paton's folds

-1/2Peripapillary swelling

-1 preretinal heme

-1 retinal ischemia

-1 retinal tear

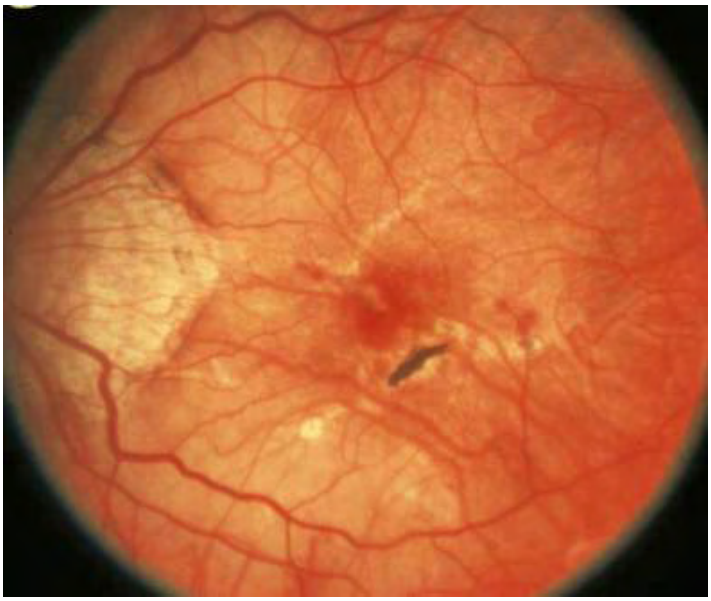
-1 retinoschisis

-1 silver wiring

-1 vitreous hemorrhage

Appendix 2 (continued)
Example of Grading Key Fourth-Year Clinical Post-test 2007

PART 4A PHOTO A



A 60-year-old white male presents as shown in PHOTO A. The patient has noticed blurred vision in the left eye, which started about 4 days ago. The patient was otherwise asymptomatic. Entering DVA was OD 20/30 and OS 20/40 and NVA was OD J2 and OS J3 with a habitual correction of -8.50 spheres OU and +2.00 add. OU. No improvement on pinhole testing. Refraction showed OD -9.00 OD and – 8.75= 75 x 90 OS and =2.25 add OU, yielding DVA OD 20/20, OS 20/40 and NVA OD 20/20, OS 20/40. One year ago the patient saw 20/20 at distance in each eye with the habitual prescription of -8.50 OU. The pupillary responses were normal. The eyelids showed mild meibomian gland dysfunction with tear frothing along the lacrimal lake OU. Both corneas showed prominent Hudson-Stahli lines and Type I limbal girdles. Prominent central guttata were present OU. The anterior chambers were normally formed. The vitreous and aqueous humors were clear and acellular OU. The lenses were clear OU. 78D examination of the posterior pole of the right eye revealed similar presentation as seen in PHOTO A of the left eye. Amsler grid testing was normal OD, but showed metamorphopsia OS. 20D BIO examination of the right eye revealed 2 areas of lattice degeneration about ½ by 2 Disc Diameters without breaks in the superior temporal and inferotemporal quadrants respectively. The left eye revealed a single area of lattice about ½ by Disc Diameters with breaks visible and I DD of surrounding edema on the ends of the lesion, which was located in the superior temporal periphery. IOP was OD = 15, OS = 15 mm Hg at 9:00 AM.

Review of systems indicates early onset hypertension beginning at age 50 for which the patient takes HCTZ once daily

Appendix 2 (continued)
Example of Grading Key Fourth-Year Clinical Post-test 2007

1. Based on the fundus findings and case history, list your diagnosis and briefly explain your rationale for choosing this diagnosis.

Grading the diagnosis is worth +5 in this section and 3 points for rationale max for this section is +8 even if more rationals are correct

Lacquer cracks OS or degenerative myopia 5 points

High myope with white linear marks in the macula region+3
High myopia +2
Myopic degeneration +3
Wet AMD+1
Metamorphosia +1
-8.50 myope+1
Lattice degeneration+1
Parapapillary atrophy +1

2. Create an appropriate problem and plan

Problem

(2pts) 1. Lacquer cracks OS

(1pts) 2. Several Areas of Lattice Degeneration
One with breaks visible and surrounding edema

(1pts) 3. Meibomitis

(1pts) 4. Prominent guttata OU

(1pts) Fuch"s

Plan

(+2pts) 1. refer for FAA and or OCT
if they just write refer +1
if they say refer to then give +2

(1pts) 2. Refer for possible laser treatment

3. Warm compresses and lid scrubs

4. Monitor yearly for progression to

Total 8
Just myopic degeneration in problem +1
Just CNVM +1
If they put send to PCP for general elastic tissue workup +1 total for problem and plan
If they put polycarbonate lenses +1
Note on number 3 and 4 they must have both the problem and the plan correct to get +1

A Comparison of Learning Styles Across the Decades

Tressa F. Eubank, OD, FAAO, FCOVD
Jill Pitts, OD

Abstract

Purpose: *To determine whether "Millennial" students' approach to learning in our Southern College of Optometry (SCO) curriculum is different from a previous class of optometric students classified as Generation Xers.* ***Methods:*** *The 1976 format of the Kolb LSI Learning Style Inventory was placed on the intranet. Students currently enrolled in all four years of the SCO optometric curriculum were invited to voluntarily complete the survey. The primary investigators determined which category of learner the students were based on the survey answers. These findings were compared to the research done in 1993 using the graduated Class of 1994.* ***Results:*** *There were 167 respondents, 90 females and 77 males. They completed the 12-question survey, identifying which learning statement was most like them. Upon review of the data, a demonstrable shift in learning styles between the class surveyed in 1993 and that of 2010 was found. Given that the data are categorical, a nonparametric test was used. A chi-square test showed that the distribution of learning styles is different ($p<0.00001$). In 1993, SCO's Gen-X learners were primarily comprised of two major categories, Assimilators (45.3%) and Convergers (37.2%). Divergers accounted for 12.7% of responses, with very few Accommodators (4.6%) found. The 2010 data revealed a fairly even distribution between Assimilators (28.1%) and Divergers (26.3%), followed by Accommodators (20.9%) and Convergers (16.7%), while 7.7% students were placed into the Mixed category as they did not demonstrate a strong preference for any individual learning style. The data revealed a significant decrease (45%) in the percentage of students who are classified as Convergers and a 62% decrease in those who are classified as Assimilators.It also revealed a significant increase (200%) in the number of students classified as Divergers. The greatest change (450%) was found in those students who were classified as Accommodators.* ***Conclusions:*** *The data revealed a significant drop in the percentage of students who prefer to learn through abstract conceptualization. It also revealed a significant increase in those students who prefer to rely on concrete experience, their own imagination and intuition when learning. The greatest change found was the number of students who prefer to combine concrete experience and active experimentation to learn and solve problems using their own intuition.*

Key Words: *Teaching, educational assessment*

Dr. Eubank is a Professor at Southern College of Optometry and Clinical Consultant to the Vision Rehabilitation Service at The Eye Center, where she is currently concentrating on developing the Acquired Brain Injury Service. She served as Faculty Chair for two terms and has been a member of the Curriculum Committee since 1998.

Dr. Pitts graduated from Southern College of Optometry in 2003 and completed the Ocular Disease residency program at the State University of New York in 2006. She joined the Southern College of Optometry faculty as an instructor in 2008, primarily teaching in the Primary Care and Ocular Disease clinics. Currently, she divides her time between instructing students in the classroom, laboratory and Primary Care clinics.

Background

Studies investigating the relationship between learning styles, personality traits and educational achievement can be found in educational and psychological literature.[1-5] As optometric educators, it behooves us to be aware of the learning styles and personalities of our students so that we may enhance the delivery of our curriculum and the environment in which it is presented.[6-8] It is not our intention to 'label' a student using a personality profile questionnaire or learning style category, but to identify the personality/learning styles of our students to allow both the instructor and the student to improve the learning process for the successful matriculation through our optometric curriculum.

Today's students think and process information fundamentally differently from previous generations that have been educated in our optometric program.[9] Presentation of the optometric curricula, both didactic and clinical, requires that students be able to acquire information in a manner that is deemed meaningful, presented in a format that is easy to assimilate, allows transfer of knowledge attained to knowledge-in-use, and considers their individual learning styles. Much has been published about the current changes in adult learner/worker attitudes and performance; management techniques are also evolving in academic and workplace settings.[10,11] Review of the generational characteristics of the Baby Boomers, Generation X and the present generation, which is labeled Generation Y, The Millennials or Digital Natives,[12, 13] will demonstrate how the latter approaches relationships, meaning and value of education, role in society, family and learning.

Our current student population is accustomed to rapid acquisition of information, whether it is for education, recreation or social/relationship purposes. The ever-changing and upgrading of cellphone technologies has already made traditional computers obsolete. Downloading of images and documents no longer requires a laptop or desk-based computer.

Studies of learning styles and testing instruments used have been based on J.D. Vermunt's Inventory of Learning

Styles (ILS) in Higher Education.[14,15] He theorized that four learning styles existed: meaning directed, reproduction directed, application directed and undirected. Vermunt postulated that students falling in the undirected learning style category may have difficulty processing the material, discriminating the key points in the material, and be overwhelmed with the amount of material to be studied. The student who uses the reproduction directed learning style will "study for the test" and then forget what is learned. Students using the application directed style will try to assimilate the information and then apply the knowledge gained in the real-world arena. Students who use a meaning directed approach to learning try to assimilate the information and then develop their own interpretation of its meaning and application.

The four styles identified by Vermunt[15] correlate nicely with Kolb's[16,17] categories of concrete experience, active experimentation, reflective observation and abstract conceptualization as well as his classifications of Converger, Accommodator, Assimilator and Diverger.

Busato,[1] et.al., found that a correlation existed between Vermunt's ILS[15] personality styles and Kolb's[17] learning styles. Five personality factors were named in his study: extraversion, agreeableness (also referred to as sociability), conscientiousness, neuroticism, and openness to experience (also referred to as intellect or culture). These five personality traits were also found to be educationally relevant in research done by de Radd and Schouwenburg as noted in Busato's paper. Extraversion and conscientiousness were highly correlated with the learning styles that were meaning directed, reproduction directed and application directed. This may resemble the attributes of Kolb's[17] Convergers (thinking and doing) and Accommodators (feeling and doing). Conscientiousness and openness to experience were negatively correlated with the undirected learning style, while neuroticism also correlated positively with the undirected learning style.

Kolb's[18] research resulted in the identification of four basic learning style categories: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experimentation (AE). He then divided learners into four categories: Convergers, Divergers, Assimilators and Accommodators characterized by a dual combination between the actions of the aforementioned categories as listed below.

Kolb's[18] classifications are presented as follows:

Convergers: Combination of Abstract Conceptualization (AC) and Active Experimentation (AE)

- Find practical applications for ideas and theories
- Generally, more technical than social
- **Thinkers and Doers**

Divergers: Combination of Concrete Experience (CE) and Reflective Observation (RO)

- Tend to assess a situation from several viewpoints
- Combine concrete experience with reflective observation
- **Feelers and Watchers**

Assimilators: Combination of Abstract Conceptualization (AC) and Reflective Observation (RO)

- Organize information into a concise, logical form
- Usually find theoretical logic more significant than practical application
- **Thinkers and Watchers**

Accommodators: Combination of Concrete Experience (CE) and Active Experimentation (AE)

- Depend heavily on practical hands-on experience
- Tend to act on what feels appropriate rather than what is logical
- **Feelers and Doers**

Felder & Solomon[5] identified four dichotomies of active/reflective, sensing/intuitive, visual/verbal and sequential/global for their learning styles categories, which Lizotte[3] usedin his research. They have postulated, like Kolb[15], that knowledge of one's preferred learning style can be used to assist and enhance one's journey through the educational arena. Modification and broadening of one's learning style is possible through strategies recognized in the instructional arena.

With all of this being said, questions arise. Have new technologies changed the learning styles of our students? Do the students of today approach learning the same way as those of previous generations? This research project provides insight into how members of Generation Y, aka the Millennials, approach learning as compared to our previously surveyed graduated Class of 1994[9], aka Generation X.

Methods and Materials

The 1976 Kolb Learning Style Inventory[18] was chosen as the vehicle to use to determine our students' learning style. Of note is that the 1993 survey was done on paper and hand-graded by the first author (a "digital immigrant"). The present survey was placed on the institution's intranet and scored via Microsoft Excel spreadsheet (at the recommendation of the co-author (a "digital native").

Students currently enrolled in all four years of our optometric curriculum were invited to voluntarily participate in this project, which was first reviewed by the IRB. The 1976 format of the Kolb LSI Learning Style Inventory[18] was placed on the intranet with 167 students responding. Ninety females and 77 males anonymously completed the 12-question survey in which they identified which learning statement was most like them. The primary investigators then determined which category of learner the students were based on the survey answers. The data were reviewed and compared to the responses of the 1993 research by one of the authors.

Results

Upon review of the data, a demonstrable shift in learning styles between the class surveyed in 1993 and the class surveyed in 2010 was found. Given that the data are categorical, a nonparametric test was used. With four degrees of freedom (one minus the number of categories), the Chi-square test showed that the distribution of learning styles is different. ($p < 0.00001$).

In the 1993 research, Gen-X learners enrolled in our optometric program were primarily comprised of two major categories, Assimilators (45.3%) and Con-

vergers (37.2%). Divergers accounted for 12.7% of responses, and there were very few Accommodators (4.6%). The 2010 data (Table 1) revealed a fairly even distribution between Assimilators (28.1%) and Divergers (26.3%), followed very closely by Accommodators (20.9%) and Convergers (16.7%), and 7.7% of students were placed into the Mixed category, as they did not demonstrate a strong preference for any individual learning style.

The data (Table 2) reveal a significant decrease (45%) in the percentage of students who are classified as Convergers (learning through abstract conceptualization, creating theoretical models and applying them to learn, and active experimentation), and a 62% decrease in those who were classified as Assimilators (learning by logical application of information). The data also reveal a significant increase (200%) in those students classified as Divergers (learning by relying on concrete experience, their own imagination and intuition). The greatest change found in an individual learning style category was the four-fold increase (450%) in the percentage of students who were classified as Accommodators (prefer learning by combining concrete experience and active experimentation to learn and solve problems using their own intuition).

Table 1
Comparison of LSI Responses, 1993 and 2010

LSI 1993 Survey			LSI 2010 Survey		
LSI Classification	# of Students	% of Students	LSI Classification	# of Students	% of Students
Convergers	32	37.2%	Convergers	28	16.7%
Divergers	11	12.7%	Divergers	44	26.3%
Accommodators	4	4.6%	Accommodators	35	20.9%
Assimilators	39	45.3%	Assimilators	47	28.1%
Mixed	0	0	Mixed	13	7.7%
Totals	86		Totals	167	

Table 2
Changes from 1993 to 2010

	Absolute % change	Relative % change from 1993-2010 % students (1993) - % students (2010) / % students (1993)	p value
Convergers	20.5%	45% decrease	0.0005
Divergers	13.6%	200% increase	0.0206
Accommodators	16.3%	450% increase	0.0013
Assimilators	17.2%	62% decrease	0.0094

Conclusion

The distribution of preferred learning styles of optometry students in our educational program has changed significantly over the past 17 years, with the emphasis shifting from learning through abstract conceptualization to learning via experience and experimentation. The data reveal a significant drop in the percentage of students who prefer to learn through abstract conceptualization and a significant increase in those students who prefer to rely on concrete experience, their own imagination and intuition when learning. Awareness of students' preferred learning styles may be helpful not only in how the curricular content is presented, but in the structural design and instructional technology needed to maximize the learning experience of the future optometry student.[6,7, 18-20]

Curricular review is an ongoing process at SCO. Future considerations at our optometric institution include the development of a new multipurpose lecture hall, more areas for small group learning, enhanced library environment, and enhanced utilization of instructional technologies.

The fairly even distribution between the Divergers, Accommodators and Assimilators found in the 2010 survey, the decrease in the percentage of Convergers and Assimilators from the 1993 survey, and the increase in Accommodators from the 1993 survey may lead one to ask several questions. Is the same curricular andragogy (curricular content and its delivery) as effective as it once was? Will knowledge of an individual student's learning style be useful in cases of remediation? How does the advent of the ever-increasing digital world of internet, computers, texting and video capabilities affect the delivery of the optometric course content?

In their learning and teaching styles paper,[5] Felder et. al., discussed methods to assist learners in their educational journeys. Our success in addressing the personality/learning styles of our forthcoming Generation Y students will be measured by the successful completion of the modified optometric didactic and clinical curriculum. The authors would like to invite the other schools and colleges of optometry to share best practices in curricular delivery and to perhaps form an ongoing blog on their didactic and clinical experiences with this new generation of students.

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A Backward Glance on Optometric Education: Institutional Profile of Schools and Colleges of Optometry

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Abstract

This paper discusses the rich history, current institutional profile and future of optometry schools and colleges in the United States in relation to core competencies. The optometric profession arose from the public's need for eye care and its unavailability within the United States in the early 1600s. Optometry schools began as informal proprietary colleges and have become formal, structured, accredited four-year programs that offer a Doctor of Optometry (OD) degree as well as other degrees in physiological optics and vision science.

Key Words: *History, optometric education, optometric demographics, core competency*

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Introduction

The optometric profession arose from the public's need for eye care and its unavailability within the United States in the early 1600s. Optometry schools began as informal proprietary colleges and have become formal, structured, accredited four-year programs that offer a Doctor of Optometry (OD) degree as well as other degrees in physiological optics and vision science. In the past five years, optometric education has seen a rise in the number of optometric educational institutions. Also, over the past 50 years, the profession has steadily grown and developed from one of refractionists to one of primary care healthcare providers for the eye. In light of these trends, reflecting on the past history of the profession, its current status and future will provide an enlightening overview of the development of the profession.

In this respect, it is important to understand the history of educational institutions to fully understand the history of professions and their relative impact on society. This information can be used as a tool for reflection and guidance for current and future institutions as well as assist students in better understanding the roots of their profession. Furthermore, the history of optometry can help guide our future and bears weight on discussion of important concepts such as core competencies. This paper will discuss the rich history, current institutional profile and future of optometry schools and colleges in the United States, and core competency development.

History of Schools and Colleges of Optometry

In 1620, the first pair of spectacles arrived in the New World. Over the next 250 years, there was a strong force to hasten optometry's development from its roots as an optical business into a healthcare profession. Originally, the trade profession of optics was learned through apprenticeship. Charles Prentice fought for standards to ensure that the public received the finest optometric service. Then, the profession of practicing refractionists evolved to meet the needs of the public; however, lenses

were only available in Europe. In 1833, jewelry businessmen began to produce spectacle frames in Massachusetts. By 1852, the demand grew, and approximately 15,000 frames were made per year. [4] Between 1890 and 1900, many spectacle lenses and optical instruments were produced in the United States, thereby decreasing our dependence on Europe.

In 1907, the first school of optometry, the Needles Institute of Optometry, was established in Kansas City, Mo. It eventually relocated to Chicago to merge with the Northern Illinois College of Optometry.[5] In 1905, the Massachusetts School of Optometry was established from the reorganization of the Klein School of Optics, which began in 1894 with a mission to instruct opticians on the diagnosis of diseases of the fundus using the ophthalmoscope.[6,7] The Massachusetts School of Optometry was later renamed as the New England College of Optometry (NECO) in 1976. All three schools were based in Boston, although there were several relocations between different buildings.[8,9]

The Illinois College of Optometry (ICO) was formed in 1955 with the merger of the Chicago College of Optometry and the Northern Illinois College of Optometry, which were founded in 1946 and 1926 respectively.[4] The Northern Illinois College of Optometry had its roots within the Chicago College of Ophthalmology and Otology, established in 1872, where opticians were trained by physicians on the use of practical methods using prisms and on detection and correction of optical defects using the ophthalmoscope.[10,11,12]

Additionally, the Los Angeles College of Optometry began in 1921 from the Ketchum School of Optics that was established in 1904 and later became the Southern California College of Optometry (SCCO).[6,13] All three of these institutions had many changes and relocations that mimicked the many changes that the optometric profession underwent. Southern California College of Optometry, Illinois College of Optometry and New England College of Optometry all originated from optics schools at a time when the optometric profession did not exist.

Concurrently, courses were offered to optometrists throughout the country, hence the beginning of optometric education and the profession as we know it today.[4] In 1900, the American Optometric Association (AOA) elected its first president. The AOA aimed to support optometrists through legislative processes. In 1915, the AOA passed a resolution that defined the minimum length of optometry courses. This resolution required upgrading the original optometry schools, including the disqualification of 20 schools.[4]

In 1914, the first public college of optometry, The Ohio State University, was founded. It granted its first degree in 1915, a Bachelor of Science in Optometry.[6] From 1894-1932, five additional private schools and colleges of optometry were established.[14] In 1927, Pennsylvania College of Optometry was the first institution to grant a Doctor of Optometry degree after completion of a four-year curriculum.[6] In 1922, the American Academy of Optometry (AAO) was founded with 11 charter members. Their mission was to increase the professionalization of optometry and move away from commercial optometry.[15] The AAO conducted post-graduate courses and encouraged the formation of local chapters nationally and internationally.[6] It also began to hold annual meetings to serve as a forum and meeting place for optometrists where continuing education and research is highlighted.[6]

By 1925, a committee of volunteers, known as the Council on Optometric Education (COE), was appointed to accredit optometric education institutions. The COE became the current optometric accreditation body known as the Accreditation Council on Optometric Education (ACOE). Optometric education began to flourish over the next 10 years, reaching a pinnacle when OSU offered a PhD degree in physiological optics under the direction of Dr. Glenn A. Fry. From 1935-1955, optometric education grew to encompass a formal curriculum, which was a six-year professional course consisting of a two-year liberal arts program combined with a four-year specialized professional education.[6]

In 1947, the American Optometric Foundation (AOF) was created to promote the growth of optometric science through support of graduate students in vision science research.[4,6] Initially, the AOF was primarily funded from within the profession, but as more public and governmental agencies relied on it for guidance in vision research and care, the funding for the AOF expanded to include the public.[6] The AOF has played an important role in shaping and supporting optometric education through its support of researchers and educators.[6]

From 1945-1988, eight additional public colleges of optometry and one additional private school were established.[14] This growth in public and private institutions parallels the immense growth of undergraduate and graduate institutions across the United States.[1,16]

Current Status of Optometric Education

At this time, there are a total of 23 accredited schools and colleges of optometry. Twenty are members of the Association of Schools and Colleges of Optometry (ASCO), and three are affiliate members of ASCO. The 20 member schools are located within the United States and Puerto Rico, and the affiliate members are located in Canada and Columbia.[17,18] The 20 ASCO member schools within the United States and Puerto Rico are shown in Table 1 with their founding dates, class size and institutional organization. All 20 of the schools and colleges offer a four-year optometric curriculum granting the Doctor of Optometry degree.

Most optometry schools strongly recommend if not require a bachelor's degree for applicants.[20] New England College of Optometry offers additional unique degree programs for foreign-trained optometrists that encompass an abridged curriculum.[26] Other schools offer dual degree programs whereby students interested in research and public health can receive an additional Master of Science, Doctorate of Philosophy or Master in Public Health degree.[20] In the past 40 years, the number of schools and colleges of optometry has almost doubled. Furthermore, there are three additional institutions, Western Uni-

versity of Health Sciences, Midwestern University Arizona College of Optometry and University of the Incarnate Word, whose optometry programs had been granted preliminary approval by the ACOE and were preparing to admit their first incoming classes in Fall 2009.[21,24,25]

Future of Optometric Education

In 1968, Hirsch and Wick predicted the creation of additional university-affiliated colleges resulting in a total of 20 university-affiliated schools to completely attain optometry's professional status and fulfill the optometric demand placed by society. They advocated the replacement of independent schools and colleges with university affiliation to promote professional recognition as evidenced by the history of dental and pharmacy schools, but recognized the important contributions made by the independent schools and colleges of optometry.[6]

Recently, many healthcare professions recognized by society, including medicine, nursing and pharmacy, have retained their professional status in society while offering education through both university-affiliated and independent schools and colleges.[27,28,29] Therefore, the prediction of all educational institutions being university-affiliated seems to be an unrealistic goal for our profession if we are to continue to serve all members of society. We must remember the importance of all optometric educational institutions as they serve our profession and continue to contribute to society as stated in the AOA mission.[30] Our profession has changed as rapidly as society in general has changed.[31] We must remain at the forefront of education by constant evaluation of our academic programs, curriculum, faculty needs, student expectations and institutional mission, vision, goals and objectives.

The history of optometry schools is important because it is one of the few professional schools that began as proprietary schools with a commercial focus.[4,6] Both the change in pedagogy and change in ethnic demographics have been slow in optometry, which is consistent with other educational professions.[32] The futures of optometry schools and the optometric profession depend on their current actions and objectives to meet the needs of the public and the future students. Educational institutions need to focus on their unique differences as defined by their mission and vision to remain viable in the future and must remain cognizant of their rich past.

Table 1
Historical Perspective of U.S. Public & Private Optometry Schools and Colleges [4,6,17,19,20,21,22,23,24,25]

Name of Institution	Founding Year	Private/ Public	Number of Students/ Yr
Illinois College of Optometry (ICO)	1872	Private	158
New England College of Optometry (NECO)	1894	Private	115
Southern California College of Optometry (SCCO)	1904	Private	98
Inter American Univ. of Puerto Rico (IAUPR)	1912	Private	50
The Ohio State University (OSU)	1914	Public	64
Pennsylvania College of Optometry at Salus University (PCO)	1919	Private	155
University of California at Berkeley (UCB)	1923	Public	60
Southern College of Optometry (SCO)	1932	Private	123
Pacific Univ. College of Optometry (PUCO)	1945	Private	89
Indiana University (IU)	1951	Public	78
University of Houston (UH)	1952	Public	105
University of Alabama at Birmingham (UAB)	1969	Public	44
State University of New York (SUNY)	1970	Public	72
Michigan College of Optometry (MCO-FSU)	1975	Public	36
University of Missouri - St. Louis (UMSL)	1980	Public	44
Northeastern State University - Oklahoma College of Optometry (NSU-OCO)	1988	Public	26
NOVA Southeastern University (NOVA-SE)	1989	Private	101
Western University of Health Sciences (WesternU)	2009	Private	70
Midwestern University - Arizona College of Optometry (AZCOPT)	2009	Private	50
University of the Incarnate Word (UIW)	2009	Private	60

Competency in Healthcare Professions

What is the relationship between the development and continuation of our profession and optometric education? Historically, it has been shown that optometric education has been at the forefront and was instrumental in developing our profession. Now, there are additional stakeholders and facets

to optometry. Healthcare professionals are held to a certain standard by the public and are expected to be competent and qualified. The public expects state boards to ensure competency in their healthcare professionals as well as active involvement in maintenance of competence initiatives.[33] Competency has been defined as the ability to perform a job adequately. However, an education curriculum should prepare students to not only be competent as defined, but also to have the pertinent skills and knowledge necessary to represent competent professionals.[34] This skill set represents core competencies that all healthcare professionals must understand before practicing in their profession.

Empirical Studies

The literature contains many articles on the benefits of core competencies for various professions as well as benefits of competency-based education.[35,36,37,38,39,40] Most healthcare professions have adopted a competency-based education curriculum through extensive education reform, some of which was introduced by outside sources such as the government or the public.[36]

Competency-based education has the potential of improving the quality of education and the quality of the students. Much of the emphasis on education reform towards a competency-based model has been on improving the talents, aptitudes and abilities of the students, thereby improving their quality of life.[35] In healthcare professional education, the benefits in quality of life extend to the patients and towards their quality of care, hence, the heavy involvement from federal agencies to ensure that the public receives valuable, quality healthcare.

Roles of Regulatory Boards and Professional Organizations in Policy Development and Implementation

In 2000, a Committee on Attributes from ASCO compiled and developed competency statements focused on knowledge, skills and professionalism. Table 2 explains each competency category.

Table 2
Competency Statements from ASCO [41]

Knowledge
knowledge of basic body systems, processes and causes leading to dysfunction or disease, mechanisms of action of pharmaceutical agents, structure and processes contributing to refractive error, optics of the eye and ophthalmic lens systems, visual development and visual function, vision therapy and rehabilitation, understanding of psychosocial forces affecting patients, practice management strategies and structures, and elements related to clear verbal and written communication
Skills
cognitive and motor skills necessary to prevent, diagnose, treat and manage clinical conditions within the optometric scope of practice
Professionalism
Personal - including a commitment to life-long learning, incorporation of ethical principles into patient care decisions, problem solving and critical thinking skills, and the recognition of one's personal limitations in patient care
Professional - including application of professional ethics and standards in the practice of optometry, demonstration of honesty and integrity, respect for patients and commitment to confidentiality, understanding potential conflicts of interest in health care, and a commitment to active involvement in organized optometry

However, I argue that competency is much more than knowledge and skills. Core competencies should also include demonstrable critical thinking skills, communication skills, and the integration and application of knowledge and skills.[34] Psychosocial and interprofessional competencies are usually introduced during the last two years of the optometric program when students are performing their clinical rotations but should be intertwined throughout the entire currriculum.

Core Competency Development

The development of core optometric competencies needs to include needs of the public, standards of the profession and attainable objectives of educational curriculums. General core competencies in other healthcare professions such as medicine have focused on patient care, medical knowledge, practice-based learning and experiences, interpersonal and communication skills, professionalism, and systems-based practice, which is a more inclusive definition.[42]

Competencies must also address global and interprofessional concerns or needs. There is much disparity in the scope of practice and the definition of an optometrist from a global perspective; however, vision care has a dramatic effect on individuals and communities throughout the world. There are global conferences and organizations focused on education and public health in vision care that can be used as a resource to expand core competencies to involve global needs, concerns and expectations.

Reimers claims that schools and colleges are not preparing their students for global challenges and consequences that include a lack of internationalization.[39] It is predicted that over the next 15 years, there will be major changes globally as related to politics, environment and healthcare. Students must have global competency that has been defined as the knowledge and skills necessary to cross disciplines, comprehend global events and respond effectively.[39,43]

Interprofessionalism has been defined as the interaction between practitioners from different healthcare professions to improve quality of patient care.[44] It also involves interaction and collaboration between professionals who understand each other's disciplines. Interprofessional professionalism has been defined as the "consistent demonstration of core values [and the application of] altruism, excellence, caring, ethics, respect, communication and accountability to achieve optimal health and wellness [in patient care]".[45] Interprofessional behaviors and skills must also be included in competencies with optometry for the sake of excellent patient care and col-

laboration with other healthcare professionals.

Interprofessional behaviors have been defined as determining the best plan for patient care, demonstration of cultural competence, challenging the status quo when patient care is ineffective, involvement in team coordinated patient care, implementation of interprofessional teaching in chronic illness, and other collaborative behaviors to improve patient care.[46] These behaviors can be taught and reinforced through effective teaching methodology in clinical rotations.[47] The faculty and staff must understand and acknowledge the already adopted core competencies in order to implement and/or evaluate them.

Core competencies and maintenance competencies are tightly woven and have the potential of impacting optometric education institutions. The maintenance competency process has the potential of increasing the competition in optometric residency programs and may increase the need for more residency programs. Currently, optometric residencies are optional and are limited to 300 positions at 165 sites.[48]

Conclusion

There are many benefits to establishing core competencies in optometry. The investment in competency-based education can facilitate the development of good citizens with democratic tendencies.[35,49] Education reform is an ongoing process and requires reassessment and readjustment of current policies and curriculums. Education reform also encourages the adoption of new perspectives to expand national development of our citizens and society.[35]

A core competency policy is important because it diminishes the silo effect that occurs within health professional schools. It also enhances collaboration and coordination of patient care that is important in quality healthcare delivery. Lastly, a core competency policy will better educate and prepare students for their futures.

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Best Practices in Debt Management for Optometry Students

A Roadmap from Inquiry to Graduation

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Abstract

Debt management can be a significant problem for all students pursuing higher education today, not just optometry students. Learning how to manage debt begins before students enter an optometry program and continues, in some cases, after graduation. In 2008, the Association of Schools and Colleges of Optometry (ASCO) gathered information from the financial aid administrators at ASCO institutions. They provided information on how they helped students minimize their debt. This paper presents the input from their responses and shares some of the best practices at specific optometry institutions that can be used to help optometry students at different stages of their optometric education experience.

Key Words: *Student debt management, best practices*

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Introduction

Many students enrolled in schools and colleges of optometry will accrue significant levels of debt while pursuing their degrees. Among a variety of different healthcare providers, student debt has been shown to influence choice of specialty,[1,2,3] quality of life,[4] practice opportunity selection[5] and career decisions.[6] Debt incurred for health professions education must also be considered as additive to the undergraduate debt burden. A national study found that on average, student borrowing contributes to 14% of the costs of undergraduate education, with parent borrowing contributing another 10%.[7] Borrowing is widespread, with an increase in the percentage of families who borrow to pay for college from 42% in 2009 to 46% in 2010.[7]

Specific to the profession of optometry, past research indicates that the average 1990 optometric graduate accumulated $49,703 of debt for both undergraduate and optometric education. In 1996, this value increased by more than 64% to an average debt level of $81,627.[8]

The Association of Schools and Colleges of Optometry (ASCO) Matriculating Student Survey from 2009 asked students to self-report both their level of debt from their undergraduate education and their estimated level of debt that would be incurred for their optometric education. Surprisingly, 50% of the respondents indicated that they had no debt from their undergraduate years. The next largest group of responders (16%) indicated they had $10,000 to $19,999 of debt, followed by 9% who indicated they had $20,000 to $29,999 in debt. The highest level of debt was reported by 3% of the respondents at $50,000 or more. When predicting their estimated debt level solely for optometry school, the four most frequently selected levels were $110,00 to $129,000 (19%), $130,000 to $149,000 (18%), $150,000 to $174,000 (14%), and $175,000 or more (19%).[9]

It is important that students enrolled in the schools and colleges of optometry learn how to manage personal finances, and educational debt, while still meeting the rigorous demands of the optometric curriculum. Better debt management can be expected to encourage greater freedom for future practice opportunities, better quality of life, and a more

secure financial future for graduates.

In 2008, financial aid administrators from around the country participated in a survey sponsored by the ASCO member institutions. The goal of the survey was to share their "best practices" for minimizing debt and maximizing students' understanding of how to manage their debt load.* Information obtained in the survey was compiled to summarize each institution's best practice at the time of student application, at orientation, during enrollment in the program, and before graduation. The purpose of this article is to provide the results of the survey by describing those practices that span the roadmap of debt management for our future doctors of optometry, beginning when potential students first contact one of the schools and colleges of optometry and continuing throughout the students' entire professional degree educational processes.

Prospective Students Before Application

Providing prospective students with the total cost of attendance and the options available to cover educational expenses early in their interest level provides them the opportunity to learn about financial aid even before the stress of applying for entrance and interviewing begins. Providing estimated costs to a potential student and his or her family allows the student to plan ahead with the costs for undergraduate education factored into the total cost for professional education.

Many schools and colleges find it helpful to begin discussing debt management practices as early as possible. In particular, schools and colleges that are associated with an undergraduate program within their home institution may even take the opportunity to counsel students prior to their enrollment in their undergraduate curriculum. Since a high school student may not yet understand budgeting for costs of living, it is helpful to provide a budget sheet so that he or she may begin learning about these indirect costs that may need to be covered. Items such as rent and utilities are often understood. Costs for health care, car insurance, or renter's insurance are less understood. In addition, these future students may not understand the impact of items like food costs or transportation costs.

These types of financial information may be provided in a variety of ways, including on program Web sites, at recruitment presentations, at "grad fair" programs, or during campus tours. A number of schools and colleges have participated in ASCO's Diversity Mini-Grant Program, supported by The Vision Care Institute LLC and Luxottica Retail. The goal of this program is to develop and implement activities and programs designed to recruit and retain under-represented minority students, financially disadvantaged students and first-generation college students.[10] These types of programs may also provide a great opportunity for early financial counseling.

Prospective Students at Interview Meetings

The information gathered from the survey showed that 13 of the ASCO institutions had time for the student applicants to meet and receive an in-person presentation from a Financial Aid Office staff member as part of the admissions interview procedures. These presentations include information about the average debt of graduates for the last graduating class, the expected monthly payment for the average debt, and advice on borrowing and repayment strategies. Often, the presentation on financial aid is paired with housing information to help students make wise choices to reduce costs that are within their own control. During the interview, or at acceptance, several programs provide total costs of education and an information booklet like the free Federal Student Aid publication, "Funding Education Beyond High School."[11] These materials ensure that students are provided complete information, not only about costs of attendance, but also about the possibilities of funding these costs and other factors, such as accrual of interest, associated fees, etc. Survey respondents agreed that students must be provided full information in order to make the best decisions possible regarding their optometric education.

After Acceptance, Prior to Orientation

Debt management begins with the Financial Aid Award Letter itself. The Free Application for Federal Student Aid (FAFSA) Web site (www.fafsa.gov) has substantial assistance for students. Many financial aid administrators begin the process by directing the student to this information online. A number of institutions also mail information and individual financial exercises related to financial planning and budgeting during the first year to all accepted students prior to matriculation. Individual financial aid counseling with the staff members of the Financial Aid Office is also available prior to the start of school and throughout students' optometric education.

Most institutions include many types of pre-matriculation debt management programs. Table 1 summarizes survey responses. Programs that are not currently incorporating certain aspects may wish to consider implementing some of these best practices.

Table 1
Summary of Best Practices in Pre-Matriculation Debt Management Programs

The Ohio State University provides newly admitted students a total attendance budget and other information so they are aware of the housing expenses around Columbus before they make a commitment on housing.
University of California-Berkeley's "Admit Day" provides a presentation titled "Financing your OD studies" to describe different types of loans, scholarship programs and part-time employment opportunities.
During the University of Alabama at Birmingham's (UAB) Annual Spring Visit, newly admitted students attend a welcoming program at the school where they are provided information on financial aid, offered information about potential living accommodations, and are encouraged to select first-year roommates in order to decrease living expenses.
University of Missouri-Saint Louis' Class Mixer and Debt Management Program combines a day for the new class to become better acquainted, tour various housing options on campus, choose roommates, and meet as a group for a debt management program.

** This survey was conducted by the ASCO Financial Aid Officers, reported through members of the ASCO Board, and compiled by Ms. Paige Pence, ASCO's Director of Student and Professional Affairs. In 2008, at the time the survey was conducted by ASCO, the Financial Aid Administrators group included: Barbara Brown (University of Missouri-Saint Louis College of Optometry), Bryant Anderson (Illinois College of Optometry), Carol Rubel (New England College of Optometry), Cindy Garner (Southern College of Optometry), Cindy Vance (Indiana University), John Choppy (University of California - Berkeley), Lourdes M. Nieves (Inter American University of Puerto Rico), Lupe Ybarra (University of Houston), Mark Martin (University of Alabama at Birmingham), Nancy Wencl (Michigan College of Optometry at Ferris State University), Otto Reyer (Western University of Health Sciences), Paul Todd (Ohio State University), Larry McClure (Pennsylvania College of Optometry at Salus University), Sheila Gonsalves (Nova Southeastern University), Stacie Englund (Pacific University), Tami Sato (Southern California College of Optometry), Teri Cochran (Northeastern State University – Oklahoma College of Optometry), Vito Cavallaro (State University of New York).*

Orientation

Best practices in debt management continue at orientation when the new students matriculate. Many programs step up to the challenge of providing substantial information to entering students about loans and debt management and, perhaps more specifically, about average student debt. For example, during orientation at Northeastern State University-Oklahoma College of Optometry, students are encouraged to build a lasting and productive relationship with the NSU financial aid office prior to actual enrollment in the optometry program. Table 2 summarizes the elements that survey respondents include within a basic debt management program during new student orientation.

Table 2
Information Included in Basic Debt Management Programs at Orientation

How to avoid credit card debt and identity theft
How to minimize living expenses
Borrower's rights and responsibilities when signing promissory notes
Costs of books, equipment and supplies
Requirements and options for health insurance, disability insurance, liability insurance (if required for clinic privileges)
Procedures for crediting financial aid, processing e-funds, and loan returns
Importance of keeping a good credit report or score
How to stick to a budget during all four years of the program
How to build and use a spreadsheet for budgeting purposes
Services available to students for little to no charge, such as athletic facilities, student health center, student counseling center, and other options as available particular to the campus and surrounding areas

While in School

Survey respondents concurred that the best work with optometry students occurs while they are actually enrolled in the professional degree program. More information is provided, students are surveyed, one-on-one budgeting and repayment counseling continues, and specific advice is provided directly to the students. For example, Southern California College of Optometry suggests that one way to minimize debt is to replace loan debt with work wages that does not have to be repaid. Students with good time-management skills can usually fit in 10-20 hours of work in the Federal Work Study program. Work is promoted as a way of reducing overall indebtedness by $1,000 to even $7,500 during a year.

A number of survey respondents provided specific examples of ways in which they ensure that their students are financially savvy. Some programs are integrated directly within the optometric curriculum, while others are co-curricular in nature.

Programs that are integrated within the curriculum run the range from individual lectures incorporated into courses to complete classes on business-related topics. First-year students at University of Houston are given a lecture about credit scores and how to maintain good credit throughout life. Students at Michigan College of Optometry at Ferris State University are introduced to the concepts of budgeting and personal finance in the course Introduction to Optometry in their first year of the curriculum. Topics covered include budgeting (projecting income and projecting expenses; variable and fixed expenditures), future value of money, the personal balance sheet (net worth), and a little on investments (cash, stock, bonds and mutual funds). Students are required to do a personal budget for the first nine months of their first academic year.

NOVA Southeastern University College of Optometry (NOVA) provides a course titled "The Individual Plan for Practice Success," which focuses on the business of running an optometry practice and setting up and presenting a business plan. Students are required to consider their current financial situation and analyze the facts that surface, including projected monthly loan payments and estimated starting salary. Students must consider methods they will use to achieve financial success based upon the things they have learned in the class, such as creative financing, practice management and debt management.

The Business Management courses at The Ohio State University cover topics such as personal finance, budgeting, borrowing, modes of practice, and career decisions that may affect modes of practice. These courses also focus on the business of running an optometry practice and setting up and presenting a business plan.

A number of responding schools and colleges provide co-curricular activities in the form of seminars, workshops or supplemental series about finance. At the Pennsylvania College of Optometry at Salus University, Drs. Leon Johnson and Lawrence McClure developed a financial planning workshop targeted for first-year students. The workshop was developed in coordination with the National Medical Fellowship Foundation and was funded by a contract with Health and Human Services Bureau of Student Financial Assistance. The workshop is also licensed to the Association of American Medical Colleges and American Dental Education Association in conjunction with their Summer Medical and Dental Education Program (SMDEP) and is funded by a grant from the Robert Wood Johnson Foundation.

The Illinois College of Optometry sponsors a five-part mini-series on financial literacy that is presented each year for all students. Each session in the series is 20 minutes long. To promote student attendance, the sessions are scheduled immediately following a mandatory class in the same room. The topics include personal motivation, how to read credit reports, how to improve your credit scores, compound interest (friend or foe), savings strategies (building your net worth), and personal budgeting as a professional. The materials are presented in a PowerPoint presentation with handouts and homework at each session. Attendees are invited to continue discussions with staff later in the office.

The UAB School of Optometry also conducts co-curricular activities for its students. Several years ago, in an attempt to expose students to, and prepare them for, the reality of practice, an alumni/student mentoring program was initiated. The goal of this program is to provide optometry students the opportunity to hear individual experiences related to beginning a practice or entering an established practice.

Northeastern State University- Oklahoma College of Optometry has offered a debt management seminar to all students. The session covers details of monthly loan repayment based on the average debt of the last graduating class, how much discretionary income graduates have based on salary, taxes, living and debt projections, information about credit cards and budget tips.

NOVA also provides a debt management presentation at its Fourth Year Congress, a three-day period in November when the graduating students meet together as a whole for the last time before graduation. The close proximity to graduation ensures that students have the most up-to-date information at a time when they are beginning to think about loan repayment.

It should be noted that all programs' best practices include protecting students' privacy under the Federal Educational Rights and Privacy Act (FERPA).[12] Table 3 provides examples of best practices for enrolled students.

Table 3
Best Practices for Assisting Enrolled Students with Debt Management

Newsletters or e-mail messages covering financial aid topics such as educational tax credits, credit checks and tips on credit card use
Periodic updates on changes to financial aid regulations and lending practices
Dissemination of individualized student packages with award letter, entrance and exit interviews, informational pamphlets or brochures, consumer and financial literacy information
Ongoing reminders about how to reduce long-term debt
Individualized student reports on the total cost of attendance budget, the total indebtedness in the prior semester, and a calculation of projected debt based on a 10-year pay-off
Ongoing reminders to use money that does not have to be repaid, such as work study funding, scholarships and grants
Information about consolidation, income-based repayment, extended repayment plans and prioritization of loan repayments
A requirement for students to make a decision regarding the amounts for Subsidized and Unsubsidized Stafford loans (rather than packaging in the maximum eligibility)
Information about the National Student Loan Data System (NSLDS)[13] to encourage students to monitor their loans and track their debt

At or After Graduation

Loan summary sheets, required exit interviews, information about loan repayment, consolidation and deferment, forbearance and economic hardship are standard best practices as students are finishing their educational program. Information that is presented near the time of graduation may also include details regarding estimated monthly repayment amounts, grace periods, interest rates, and a grand total of what students will repay. It is helpful to provide contact information such as the lender code, address, phone number and Web address for each lender. Additionally, financial aid administrators provide students with information about current options for delaying or reducing repayment obligations when participating in a residency program. When a graduate experiences other situations (part-time employment, opening a practice, etc.) in which his or her present income makes repayment of student loans difficult, the financial aid administrator can provide information and advice on seeking options that provide an extended repayment period or forbearance.

In addition, most ASCO institutions provide supplemental support to students as they become alumni by providing employment contract discussions and other business processes during capstone or fourth-year final events. For example, UAB offers support from a faculty member who is both an optometrist and an attorney. His services are available at no charge to fourth-year students, residents, new graduates and alumni for consultations regarding practice agreements and contracts.

Conclusion

The results of the survey show that many methods are used to help optometry students minimize their borrowing and manage their debt. McClure cautions that too frequently discussion and debate on student indebtedness focuses in only one dimension. He advises that student indebtedness must be considered in a broader context wherein educational costs, financial assistance, student borrowing, loan repayment, projected incomes and individual choices all interact within a complex and dynamic environment.[14]

Results of this survey show that ASCO's member institutions are heeding McClure's advice. Repetition and a wide array of educational materials are provided that go beyond the loan history and repayment options. A complete financial literacy education includes important information in each year of the curriculum, at the time of graduation and as graduates begin practice.

ASCO institutions offer a wide range of assistance to optometry students to help them understand, and better manage, the debt load required for students enrolled in the year 2010 and beyond. This assistance extends from the basic understanding of the terms of their loans to financial literacy to keeping a watchful eye annually on their debt loads.

Helping students understand the process of acquiring debt and paying off personal debt before beginning their optometric education and sharing with students the complete cost of attendance are vital in their understanding of basic debt management principles. Financial aid administrators can utilize programs and materials that have been developed by the Department of Education or one of the Direct Loan designated servicers. Doing this will jump-start a new program or help re-invigorate an existing program while not having to create these materials anew. As a profession, financial aid administrators have always been willing to share their best practices.

A broader study of student debt among a variety of graduate programs delved deeper into the observation that high debt-to-income ratios cause dissatisfaction among borrowers. Baum found that unfulfilled expectations play a bigger role in dissatisfaction of graduates, in that low income levels seem to matter more that high debt levels.[15] Financial knowledge that goes beyond debt management will undoubtedly work to prevent this type of dissatisfaction among optometry graduates. Optometric financial aid administrators helping students manage their debt in school and conclude with successful repayment of educational loans is an important part of helping the profession of optometry become stronger than it already is today.

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Private Practice Residency in Vision Therapy and Rehabilitation

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Abstract

The concept of a private practice residency in optometric vision therapy and rehabilitation was first advocated by Dr. W.C. Maples in an editorial in the Journal of Behavioral Optometry.[1] *Dr. Maples noted that although optometric residencies in this area of care have been available since the 1970s, a variety of factors have constrained accessibility to behavioral vision care in private practice. The principal focus of this paper is on the challenges faced by a private practice residency program and the goals of the program relative to the outcome for the resident, the residency site and delivery of vision therapy and rehabilitation services. Our perspective is that private practice residencies can benefit from the track record of institutional residencies, but present a unique set of attributes and considerations. Our primary purpose in presenting this information is to increase awareness in the academic and clinical communities about a new Southern College of Optometry-affiliated residency in vision therapy and rehabilitation as an option for post-graduates.*

Key Words: *Optometric residency, vision therapy, vision rehabilitation, private practice residency*

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The Demand for Optometric Services in Vision Therapy and Rehabilitation

There is significant need for optometric services with regard to vision and learning. As reviewed by Garzia, approximately 5% of the total school enrollment receives special educational services, with reading disability representing 80% of this population.[2] At least 20% of individuals with learning disabilities are thought to have a prominent visual information processing deficit, with another 15% to 20% having problems with visual efficiency.[3]

Similar epidemiologic need arises in the population of patients with traumatic brain injury (TBI). Because the majority of patients with TBI manifest oculomotor abnormalities, it is not surprising that difficulty with reading is a common and unmet need in individuals with traumatic brain injury.[4] It is difficult to ascertain the precise number of doctors providing vision therapy and rehabilitation services, or the number of optometric office visits per year dedicated to these services. However, surveys estimate that there are 2 million visits per year for services related to vision therapy and rehabilitation, which includes elements of sports vision and low vision, representing approximately 4% of all visits.[5]

Another way of assessing need is by the frequency of diagnostic procedures conducted. A survey of optometrists by the National Board of Examiners in Optometry shows that behavioral vision/sensorimotor evaluations were done at a frequency of 3.7% of all diagnostic procedures.[6] However, the same survey shows that convergence insufficiency was listed as a diagnosis in only 0.36% of the cases. Given that the prevalence of this condition is much higher in the population, and that this condition is readily amenable to vision therapy, this suggests that vision therapy conditions are underdiagnosed and undertreated.

The demand for vision therapy services is projected to steadily increase. We anticipate this is due to the success of two major research initiatives, the Convergence Insufficiency Treatment Trial

(CITT) and the Amblyopia Treatment Study (ATS). The CITT results suggest that the outcome for treatment of CI, the most prevalent type of binocular dysfunction, is considerably better with in-office therapy.[7] This can be expected to increase the demand for optometrists with the skills necessary to provide in-office treatment services. The ATS results to date suggest that the window for treating amblyopia is at least through age 17.[8] This effectively increases the number of treatable patients, thereby increasing the demand for doctors able to guide their treatment.

The demand for post-graduate education in vision therapy may also be linked to increased interest in board certification in optometry. Fellowship in the College of Optometrists in Vision Development (COVD) is recognized as providing a level of competency toward generalized board certification. In addition, a vision therapy residency is recognized by COVD as partial fulfillment of the requisite patient care hours required to sit for its certification examination.[9] Over the past 10 years, the number of doctors and therapists presenting for COVD certification has been steadily increasing.

Issues in Clinical Education in Private Practice vs. Institutional Practice

The basic issues that Dr. Maples presented,[1] and our elaborations, are as follows:

- Reimbursement for patient care services through institutional residencies are often predicated on third-party reimbursement, which is not the predominant mode of private optometric practice in this field. New graduates are therefore unprepared for generating income through vision therapy services in the manner in which private practices succeed in this area of service.
- The socioeconomic profile of patients being seen in institutional practice can be considerably different than those seen in private optometric practice. For vision therapy and rehabilitation, this has significant impact on compliance, travel and other logistics that influence patient care outcomes.
- Residents in institutional practice obtain valuable experiences, but these experiences are often fragmented. A private practice residency would better position the individual to integrate knowledge and experience within the framework of primary care practice.
- New graduates are sometimes discouraged when other professionals in the community offer baseless criticism of vision therapy. An institutional resident is more shielded from these issues by the reputation of the college or university at large, whereas the private practitioner must learn to deal with these issues more directly.
- Externships in private practices that excel in delivery of vision therapy and rehabilitation services have been offered through most Association of Schools and Colleges of Optometry (ASCO) institutions, and have served the profession well. Students who have participated in these elective rotations report positive experiences in gaining appreciation of the value of vision therapy services to the public and to the practice.
- Optometrists who supervise these externships increasingly look forward to their roles as teachers/mentors and appreciate the recognition the optometric institution affords them. Being an effective preceptor requires a significant degree of commitment to education. Some sites have either provided housing or a stipend toward housing for the student.
- Externships currently require a dual reporting mechanism, with the optometrist communicating the student's progress, and the student communicating the quality of the educational program. Private practice residencies would extend this mutual commitment.
- A private practice residency seeking accreditation from the Accreditation Council on Optometric Education (ACOE) has many of the same elements required to become an extern site, but entails far more rigorous ongoing procedures. Nevertheless, it has been accomplished in other areas of practice.
- The resident would contractually agree to meet the stated mission, goals and objectives of the program. The financial arrangements, beyond salary, would be developed by the office and educational institution according to the ACOE requirement. A key feature is that student loans are deferred during the period of the residency.
- The sponsoring optometrist would be required to periodically meet with the resident and teach the intricacies of conducting and administering a vision therapy practice. A major goal of the residency would be to develop a practitioner who, upon completion of the program, has the ability to successfully start and develop a practice or enhance an existing practice with an emphasis on the provision of vision therapy and rehabilitation services.
- The benefit to the optometric office would be that for that year, it would have a highly trained optometrist working in the office and generating income. The greater benefit, however, would be to the behavioral optometric community and to society in general.
- At the end of the year, the resident would be encouraged to go to another geographic area and set up his/her own practice that has a significant segment devoted to the provision of behavioral optometry. Certainly, if the practice and the resident find they are compatible, a more permanent associate or partner relationship may develop. In both instances, the ability to provide behavioral optometric care to the public would be increased.

In structuring a private practice residency, the sponsoring optometrist can build upon successful elements of institutionally based residencies in vision therapy. Private practice residencies should be viewed by educational institutions as providing the applicant with alternative rather than competing interests to an institution's in-house programs. As reviewed by Rouse and Appelbaum, a typical residency program is 10% didactic, 60% patient care, 10% teaching, 10% research, 5% thesis or

research paper, and 5% self-study.[10] The sponsoring optometrist should be an individual with either an extensive personal library or internet-based resources through which didactic and self-study modules can be guided. This encourages the resident to develop good habits toward a life-long independent pursuit of learning. Teaching can be accomplished in several ways. If the practice is an externship site, the resident can take an active role in assisting with the preceptor's function as a clinical educator. Vision therapy practices often utilize therapists, and a teaching role can be structured around case-review and various in-service presentations. Research and other scholarly activity can be engaged through the sponsoring optometrist's affiliation with a college of optometry or other affiliations. Active involvement in organizational optometry, including attendance at key specialty meetings in vision therapy and rehabilitation, should be encouraged.

Private Practice Residency Sites in Vision Therapy and Rehabilitation

There are currently 10 recommended titles for ASCO residencies:

- Family Practice Optometry
- Primary Eye Care
- Cornea and Contact Lenses
- Geriatric Optometry
- Pediatric Optometry
- Low Vision Rehabilitation
- Vision Therapy and Rehabilitation
- Ocular Disease
- Refractive and Ocular Surgery
- Community Health Optometry.

The ASCO description of a residency in optometric vision therapy and rehabilitation indicates that the majority of the didactic and clinical curricula will be devoted to topics and practice relevant to dysfunctions of eye movement, accommodative, binocular and perceptual systems, reduced visual acuity and compromised visual fields.[11] The title of each residency reflects the primary focus of the clinical subject area and indicates advanced clinical education in that subject area. Some programs choose to focus on two of the 10 areas.[12] Private practice optometric residencies in vision therapy and rehabilitation inevitably include a focus on pediatric optometry as well.

The first private practice residency program in vision therapy and rehabilitation was established by Dr. Stanley Appelbaum in 2008 in affiliation with Southern College of Optometry (SCO) under the guidance of Dr. Bart Campbell, Director of Residencies, and subsequently Dr. Cheryl Ervin.[13] Four similar programs followed, each having the principal optometrist in the practice serving as the residency supervisor.[14] The supervisor reports directly to the SCO director of residency programs, who in turn reports directly to the SCO Vice President for Academic Affairs. The current private practice residency programs are:

- **Site 1:** Vision Therapy/Rehabilitative Optometry, Appelbaum Eye Care Associates, PC, Bethesda and Annapolis, Md.

  Residency Supervisor - Dr. Stanley Appelbaum
- **Site 2:** Vision Therapy Group, Sensory Learning Center, Flint, Mich.

  Residency Supervisor - Dr. Bradley Habermehl
- **Site 3:** Pediatric Optometry/Vision Therapy & Rehabilitation, Child & Family Optometry, Wichita, Kan.

  Residency Supervisor - Dr. Patrick Pirotte
- **Site 4:** Vision Therapy, EyeCare Professionals, P.C., Hamilton Square, NJ.

  Residency Supervisor - Dr. Barry Tannen
- **Site 5:** Vision Therapy and Rehabilitation, The Vision and Learning Center at Family Eyecare Associates, P.C., Fair Lawn, NJ.

  Residency Supervisor - Dr. Leonard Press.

In each of these sites affiliated with SCO, the resident is defined as an employee of the practice, and the residency stipend is paid by the practice. The stipend is in the range of $31,000 for the year. Professional liability protection is provided by the site. Residents are required to present credentials according to the SCO policy for credentialing of residents. The financial package for the resident is offset by revenues that the resident generates for the practice through patient care. The residents must be licensed in the state in which the practice is located, and participation in third-party care is subject to the policies of the practice for its Doctors of Optometry. Applicants must complete the SCO application forms, but need not be students at SCO to apply. The sites utilize the Optometric Residency Matching Service (ORMS) and are accredited or in the process of being accredited by the ACOE.

Residency Accreditation

It is policy at SCO that each of its residency programs be fully accredited by the ACOE. Accreditation verifies that educational institutions and residency programs affiliated with these institutions have attained an optimal level of educational effectiveness, integrity and quality. In effect, the process of attaining accreditation is a determinant of educational quality. In addition, many formal actions, such as governmental funding and state licensing boards, are based on accreditation status.

The accreditation process requires educational institutions and programs to conduct a self study to determine if their mission and goals are achieved, to evaluate recommendations made by an impartial site visit team, and to execute internal actions to address those recommendations. A program is evaluated during the first year in which a resident is enrolled in a program and every seven years thereafter. This periodic review requires that programs continually monitor their program and conduct assessments of the outcomes.

Once a program and educational institution form an official affiliation and enroll their first resident, a program site visit is arranged with the ACOE. Ideally, this site visit would occur several months into the residency to ensure that there is enough measurable data to analyze. Subsequently, the site visit team formulates and submits a report to the ACOE based on its findings. The ACOE then fully accredits a program or makes recommendations that

if implemented could result in full accreditation. The program is given a specified amount of time in which to submit a progress report to the ACOE. The entire process typically takes several months; however, once accreditation status is obtained it is retroactive to the date of the initial site visit. As a result, even though residents enrolling in a new residency program will enter an unaccredited program, they should have confidence that they will graduate from a fully accredited optometry residency program. The process of obtaining accreditation can be time-consuming for a new residency supervisor; however, full support and assistance should be expected from the affiliated institution's director of residency programs.

To assist with the residency accreditation and review process, the resident maintains an activity log to document the number and types of clinical encounters. This helps ensure a broad exposure in line with the goals of the program description. The general categories of activity are:

- **Patient encounters in any aspect of patient care:** This would include participating in or conducting parent conferences, evaluation or progress evaluation. It would also include observation or secondary or principal participation or practice management.
- **Scholarly activities in any aspect of reading and/or presenting scholarly material:** This would include articles, books, internet searches on a topic, case conferences, lunch seminars, COVD meeting activities or help in preparing articles for publication.
- **Teaching of externs or therapists related to either A or B:** This would include assistance in orienting on case programming, demonstration of procedures, and role playing of administering preliminary testing, vision therapy tests and vision therapy procedures.

SCO requires that both its residency supervisors and the residents complete quarterly online evaluations. The evaluation by the resident remains confidential so that the resident is encouraged to critique the supervisor and the program constructively. Conversely, the online evaluation by the supervisor must be signed off on electronically by the resident to document awareness of incremental progress and areas identified for improvement in meeting the program's goals.

Conclusion

In this paper we have identified basic issues and challenges that both the residents and program supervisors face in maximizing success. As modeled by ASCO, the most successful graduates of residency programs are self-motivated, enthusiastic and hard-working. These are individuals who recognize early that what one gets out of the program is determined by what one puts into the program. Dedication, discipline, commitment and enthusiasm are required throughout the year of training. Not surprisingly, these are the qualities that characterize the practitioners who are at the vanguard of supervising the first wave of private practice residencies in vision therapy and rehabilitation.

It would be premature to encourage more practitioners to apply as site providers at this juncture. To date, only one resident has completed the process, so we do not as yet have data to support the success of the program. For the 2009 program, two of the three sites did not have a viable applicant and the program went unfilled at those sites. However, the application pool for the 2010 private practice vision therapy SCO residency programs had increased to an average of five applicants per site. Each of the five programs reportedly was working with an excellent resident, with several of the residents having been ranked at the top of their respective graduating classes. Our projection is that as the five current sites produce highly trained and successful residents, the applicant pool will continue to expand, thereby warranting additional sites.

It should be clear that the program is not in direct competition with institutional residencies in vision therapy and rehabilitation. Rather, it poses a viable and complementary alternative to institutional residencies. Applicants who envision a career predominantly in clinical academia or research are better served by applying to institutional residencies. Conversely, applicants leaning toward a career predominantly in private practice should be encouraged to apply to private practice residencies.

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Anterior Uveitis: Teaching Case Reports

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Abstract

Acute anterior uveitis (AAU) is the most common form of intraocular inflammation seen by eye care professionals that affects relatively younger patients, with significant distress and potentially long-lasting sight-threatening complications. The diagnosis of AAU is relatively simple for clinicians because of multiple presenting signs and symptoms; however, the etiology is often much more difficult to elucidate. Therefore, it is critical for interns and practicing clinicians to have an extensive understanding of the pathogenesis of AAU. Judicious yet effective dosage of topical corticosteroid and cycloplegic agents are the mainstay of AAU treatment. Depending on the presentation and cause, other medications, lab tests and tertiary procedures may be necessary. Finally, coordination with other specialists (i.e., ophthalmologists, rheumatologists) may be critical in diagnosis and treatment. Eye care providers play a key role in the interdisciplinary management of the patient with AAU.

Key Words: *Anterior uveitis, iritis, iridocyclitis, cells and flare, HLA-B27, corticosteroids, cycloplegics*

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Background

Two cases of acute anterior uveitis (AAU) are presented; one involving a 24-year-old Caucasian female, and the other affecting a 48-year-old Hispanic female. These cases cover one of the most common forms of 'red eye' that prompts patients to seek eye care urgently, and illustrate the clinical decision-making process arriving at the diagnosis and appropriate management. The condition is relatively common, with many third- and fourth-year optometry interns encountering it at least once during their clinical rotations. Thorough case history, careful slit lamp biomicroscopy and complete posterior segment examination are essential to correctly diagnose and treat this ocular condition. In addition, lab testing, imaging and referral to an internist and/or rheumatologist are called for in some cases.

AAU is an acute intraocular inflammation of the iris and ciliary body due to a breakdown in the blood-aqueous barrier, leading to presence of "cells and flare" in the anterior chamber (AC).[1] The diagnosis of AAU is relatively simple due to the plethora of clinical symptoms, such as photobia and painful eye, and signs, such as limbal flush, posterior synechiae, and AC cells and flare observed on slit lamp biomicroscopy. In contrast, the challenge is in determining the etiology because AAU could be a result of trauma or iatrogenic sources, an infectious agent, medications, a systemic autoimmune condition or idiopathic cause. Consequently, the differentials for the etiology of AAU can be lengthy, and a thoughtful list of questions is important in narrowing the causative suspects. For instance, questions related to recent soft contact lens wear, injury or ocular surgery can rule out their corresponding association.

Whereas age-related macular degeneration and glaucoma tend to affect older patients, AAU is a condition that affects relatively younger patients more frequently, with significant distress and potentially long-lasting sight-threatening complications.[2] Therefore, it is critical for interns and practicing clinicians to have an extensive understanding of the pathogenesis of AAU and its prompt and appropriate treatment, including

interdisciplinary co-management as indicated.

Student Discussion Guide

Case 1 description

A 24-year-old Caucasian female presented to the University Eye Clinic on June 16, 2010 with a complaint of a red, watery and painful right eye for about a day. She also mentioned that this was the third episode she had experienced on an annual basis over the past three years, with the past two episodes lasting approximately 40 days with treatment. Her medical history was unremarkable, without any ocular injury or surgery. In addition, she had denied any joint pain or bowel disease when questioned. She reported that her sister has an 'eye turn' and had been treated with an eye patch, and that her maternal uncle was recently diagnosed with glaucoma. She currently takes multivitamins and an oral contraceptive. Her last eye exam two months ago revealed normal exam findings.

At the current visit, her distance visual acuity (VA) without correction was 20/20-1 OD and 20/20+1 OS. Both eyes showed smooth, accurate, full and equal extraocular muscle movements in all fields of gaze. No pupillary defect was observed, and no notable photophobia was reported in either eye. Finger counting confrontation visual fields were full OD and OS. Anterior segment findings, as observed with biomicroscopy, demonstrated 1+ circumlimbal flush with trace cells and flare OD (Figures 1A and 1B). Goldmann applanation tonometry was 13 mmHg OD and 14 mmHg OS at 10:48 a.m. Dilated fundus examination showed a normal retina with healthy maculae and vasculature and optic nerve cup-to-disc ratios of 0.45H /O.40V OU, with healthy optic nerve head rims and distinct disc margins in both eyes.

The patient was diagnosed with recurrent, but mild, acute anterior uveitis of her right eye and educated about her findings, prognosis and treatment options. She was treated with Pred Forte (PF; prednisolone acetate 1% ophthalmic suspension) igt q2h and homatropine 5% (H) ophthalmic solution igt qhs OD. She was recommended to return to clinic a week later, or sooner if her symptoms get worse. Since the uveitis was recurrent, she was also referred for blood workup, human leukocyte antigen (HLA) testing and spinal X-ray to explore a possible systemic cause. A review of her chart records revealed that her blood workup two years ago was normal.

Figure 1A (Case 1)
Anterior uveitis OD with fibrous deposits on the lens

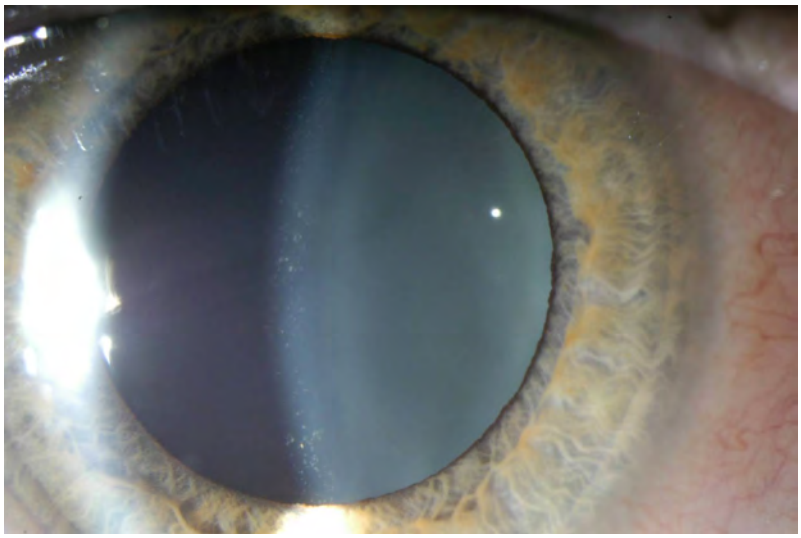
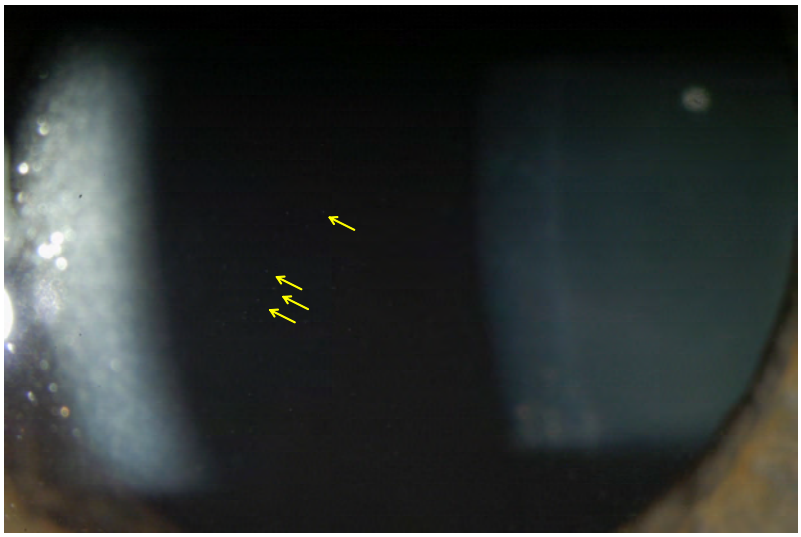


Figure 1B (Case 1)
High magnification (40X) shows cells (representative arrows) in the AC OD



Follow-up # 1: June 23, 2010

A week later, the patient felt that her eye condition was slightly worse, although her VA was still 20/20-1 OD and 20/20+1 OS. Moderate circumlimbal injection, 2+ cells and 2+ flare, was seen in the AC. The PF was increased to igt q1h OD and the H to igt bid OD. She was referred to a local rheumatologist-ophthalmologist for further consultation. Her recent spinal X-ray and blood workup were normal, with the exception that she was HLA-B27 positive. The specialist concluded that the inflammation has affected only the patient's eye so far, but in the future she will have a higher risk for arthritis, and that long-term nonsteroidal anti-inflammatory drug (NSAID) treatment may be beneficial.

Case 2 description

A 48-year-old Hispanic female presented to the University Eye Clinic on Feb 2, 2010 with a chief complaint of

painful red eye, severe photophobia and tearing OD for the past few days. She had tried an over-the-counter anti-allergy drop, but it did not help. Medical history was positive for depression and hand tremors, for which she had been taking oral vitamin B6 and Flexeril (cyclobenzaprine), respectively. She reported no joint/back pain and no pain on urination or bowel movement. Her last eye exam was many years ago, and she reported no history of ocular injury or surgery. Family medical history was negative for diabetes, hypertension, glaucoma or blindness.

At the current visit, her uncorrected distance VA was 20/150 OD and 20/150 OS, with pinhole improvement to 20/60-2 OD and 20/60+1 OS. Both eyes showed smooth, accurate, full and equal extraocular muscle movements in all fields of gaze. No afferent pupillary defect was observed; however, the patient was photophobic in her right eye. Finger counting confrontation visual fields were full OD and OS. Anterior segment findings, as observed with biomicroscopy, demonstrated 2+ circumlimbal injection and 2+ cells in the AC in the right eye. No vitreal cells or haze were seen in either eye. Posterior poles appeared normal OU with healthy maculae, vasculature, and cup-to-disc ratios of O.30H/0.30V both eyes. Goldmann applanation tonometry was 16 mmHg OD and 15 mmHg OS at 5:46 p.m.

Acute anterior uveitis with posterior synechiae OD was diagnosed, and the patient was educated about her findings, prognosis and treatment options. She was treated with a prescription regimen of PF igt q1h OD and H bid OD. The patient was recommended to return to clinic the next day for follow-up.

Follow-up # 1: Feb 03, 2010

The patient reported slight improvement in her comfort after taking the drops as prescribed, but she was still tearing and photophobic in her right eye. Her uncorrected VA was worse at 20/400 OD and the same at 20/150 OS, but pinhole improved the VAs to 20/100- OD, 20/60 OS. Anterior segment findings, as observed with biomicroscopy, demonstrated 2+ circumlimbal injection, 2+ cells and 3+ flare in the AC with posterior synechiae and fibrin membrane OD (Figure 2A). Non-contact tonometry was 10 mmHg OD and 12 mmHg OS at 9:47 a.m. One drop of phenylephrine 10% and one drop of atropine 1% were instilled in-office to attempt to break the posterior synechiae. As before, no vitreal cells or haze were seen OU. Posterior poles also were normal OU with healthy maculae, vasculature, and cup-to-disc ratios of O.30H/0.30V both eyes.

The patient was instructed to continue the PF igt q1h OD and H igt bid OD and to return to clinic in two days. A letter with request for a blood workup was sent to her primary care provider, and a rheumatological consult was also recommended.

Figure 2A (Case 2)
Anterior uveitis OD with fibrous membrane and posterior synechiae

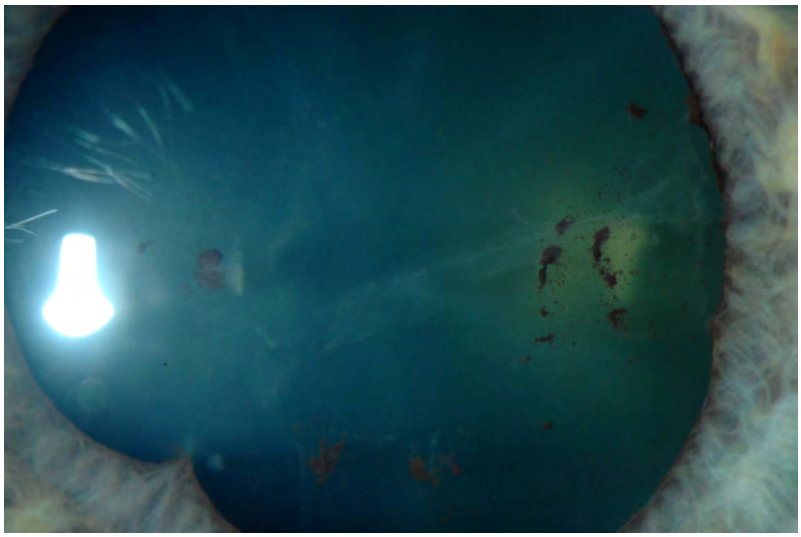
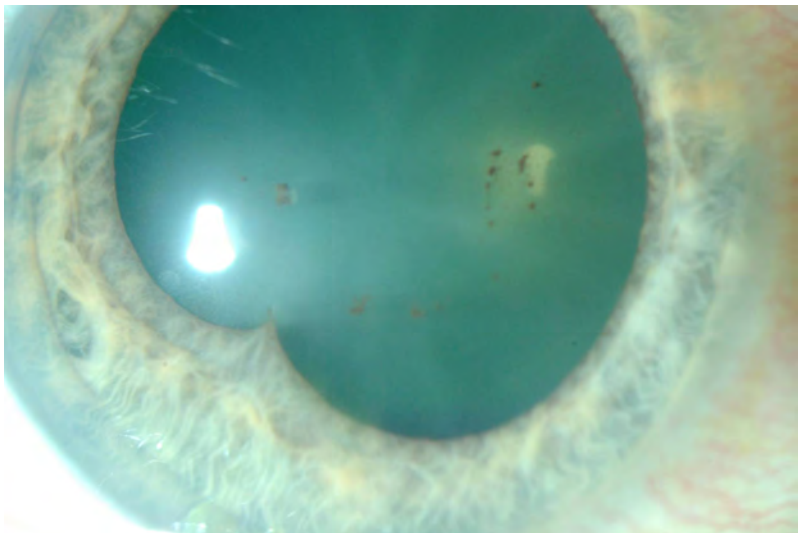


Figure 2B (Case 2)
Anterior uveitis OD. Fibrous membrane resolved with topical steroid treatment



Follow-up # 2: Feb 05, 2010

The patient appreciated further improvement over the next two days, although she still felt some discomfort and tearing. Her VA had improved to 20/80-1 (pinhole 20/40+1) OD and was unchanged OS (20/150; pinhole 20/60). Anterior segment findings, as observed with biomicroscopy, demonstrated mild circumlimbal injection, 1+ cells and 1+ flare in the AC with posterior synechiae at 7 o'clock, and resolving fibrin membrane OD (Figure 2B).

Noncontact tonometry was 12 mmHg OD and 14 mmHg OS at 3:16 p.m.

The patient was instructed to continue the PF igt q2h OD for two days and then taper to igt q4h OD for the subsequent three days, continue H igt bid OD, and to return to the clinic in five days with her blood workup results.

Follow-up # 3: Feb 10, 2010

Five days later, the patient felt that her symptoms were worse, with more pain and photophobia. Her VA was reduced at 20/150 (pinhole 20/50) OD and 20/200 (pinhole 20/60) OS. Anterior segment findings, as observed with biomicroscopy, demonstrated moderate circumlimbal injection, 2+ cells and 1+ flare in the AC with posterior synechiae at 7 o'clock OD. Noncontact tonometry was 10 mmHg OD and 15 mmHg OS at 9:59 a.m.

The patient was advised to increase the PF to igt q2h OD and H bid OD. In addition, she was prescribed oral prednisone (60mg/day for one week). She was also promptly referred to see a local rheumatologist. Her blood workup there showed high white blood cell and platelet counts, low hematocrit and positive presence of HLA-B27.

Follow-up # 4: Feb 17, 2010

A week after the combined topical and oral steroid treatment, the patient felt much better, with only mild discomfort. Her VA was 20/80 (pinhole 20/40-) OD and 20/150 (pinhole 20/50) OS. Refraction was performed, giving -3.00 -1.00 x 164 to 20/25- OD and -2.50 -1.25 x 021 to 20/25 OS with near addition of +1.50 OU. Anterior segment findings, as observed with biomicroscopy, demonstrated mild circumlimbal injection, with no cells and trace flare in the AC OD.

The rheumatologist concluded that she has HLA-B27-associated uveitis, and maintained her on oral steroid as prescribed. She was recommended to taper off her oral and topical steroid gradually over the next two weeks and to discontinue the homatropine.

Follow-up # 5: Mar 03, 2010

At this visit (almost three weeks later), the patient was off all prescribed uveitis medication, and she felt that her eye condition had completely resolved. She had not filled her spectacle prescription from the prior visit, and her VA was still 20/80 (pinhole 20/40-1) OD and 20/100 (pinhole 20/50) OS. She was educated on her recent uveitis condition and warned that it might recur in the future.

Key concepts

1. Common etiologies of acute anterior uveitis
2. Thorough case history for patients with acute anterior uveitis
3. The use of epidemiology in differentiating possible causes
4. Clinical findings in differential diagnosis of acute anterior uveitis
5. Treatment of acute anterior uveitis
4. The importance of patient education and regular follow-up
5. The essentials of appropriate systemic workup and specialist consultations

Learning objectives

1. To ask intelligent questions in helping with differential diagnoses
2. To understand the signs and symptoms of ocular inflammation
3. To relate patient demographics to known epidemiology of the AAU
4. To rule out posterior segment involvement of ocular inflammation
5. To provide appropriate patient education and optimal medical management
6. To collaborate with other health care professionals in management of possible systemic cause

Discussion questions

A. Knowledge, concepts, facts, information required for critical review of the cases
   1. Describe the signs and symptoms of anterior uveitis vs. other inflammation/injury
   2. Describe the different types of uveitis based on anatomy
   3. Discuss the cause of cells and flare in the anterior chamber
   4. Discuss the risk factors for uveitis
   5. Determine causality based on patient case history, risk factors and demographics
   6. Discuss the importance of the presence of HLA-B27
   7. Discuss systemic inflammatory diseases that have high association with AAU
   8. Describe the mechanisms of action of drugs used in management of AAU
   9. Discuss the potential side-effects of steroid use

B. Generating questions, hypothesis, and diagnosis
   1. What are important questions relevant to AAU?
   2. How is AAU diagnosed?
   3. What age group does AAU tend to affect?
   4. What are the potential differential diagnoses?
   5. Why is pupil dilation necessary?
   6. What laboratory tests are helpful in identifying the etiology?
   7. Is the diagnosis valid?

C. Management
   1. What are the different topical corticosteroids available for ocular inflammation? How are they ranked in terms of potency?
   2. Why are cycloplegics needed?
   3. Should oral NSAIDs be used?
   4. When is laboratory workup advised?
   5. What is the follow-up schedule?
   6. What course of action is necessary when symptoms get worse with treatment?
   7. When should the patient be referred to a specialist?
   8. What specialists are indicated?
   9. Why is it necessary to taper the steroid?

D. Critically assessing implications, patient management and psychosocial issues
   1. What are the implications of standard treatment vs. modified/no treatment? Consider

cost, time, side-effects, convenience effect and quality of life.

2. What are the consequences associated with noncompliance to the treatment plan?
3. What pertinent information should be used to educate the patient about the condition?
4. Discuss ways to respond to the anxiety of the patient towards future recurrence and prognosis with respect to the patient and the patient's family members.

Educator's Guide

The educator's guide includes the necessary information to discuss the case.

Literature review

The breakdown of blood-aqueous barrier in the iris and ciliary body leads to clinical signs and symptoms of acute anterior uveitis. It is the most common form of intraocular inflammation seen by eye care professionals.[1] The leakage of vascular contents into the anterior chamber can be seen as "cells" and "flare" via slit lamp biomicroscopy. A grading system was established by the Standardization of Uveitis Nomenclature (SUN) for clinical use (Table 1).[2] Cells are predominantly white blood cells (leukocytes) released in response to inflammation. Flare is comprised of serum proteins: pro-inflammatory cytokines and chemokines that selectively recruit inflammatory white blood cells. Furthermore, flare can coalesce to form fibrin, while white blood cells can precipitate in the corneal endothelium in certain forms of uveitis to form keratic precipitates (KPs). Therefore, the diagnosis of AAU is relatively simple for clinicians because of multiple presenting signs and symptoms. However, the etiology is often much more difficult to elucidate.

The annual incidence of uveitis has been estimated to be about 35 per 100,000 in the general population with a prevalence of 0.5%.[1] Of the uveitides categorized by anatomical location (anterior, intermediate, posterior, panuveitis) anterior uveitis accounts for most of the cases seen clinically.[3] The lifetime incidence of AAU may be as high as 0.2 % of the population.[4] HLA-B27, a Class I major histocompatibility complex (MHC), is a strong risk factor and associated with up to half of all cases of AAU.[5] HLA-B27-positive AAU tends to be more severe in presentation and earlier in onset than HLA-B27-negative uveitis, affecting primarily younger patients between 20 and 40 years of age.[3] In addition, males are affected 2.5 times more frequently than females in HLA-B27-positive uveitis. The prevalence of the HLA-B27 gene varies among populations, as high as 8% in Caucasians, and as low as 0.5% in Japan.[1,3]

Table 1
Standardization of Uveitis Nomenclature (SUN) grading system for AC cell and flare severity.[2] The presence or absence of a hypopyon should be noted separately in addition to the AC cellular activity grade.

Grade	AC Cells (1 mm x 1 mm beam)	AC Flare
0	None	None
0.5+	1-5 cells	-
1+	6-15 cells	Faint
2+	16-25 cells	Moderate (clear iris & lens)
3+	26-50 cells	Marked (hazy iris & lens)
4+	>50 cells	Intense (fibrin or plasmoid aqueous)

A number of systemic inflammatory diseases, such as ankylosing spondylitis (AS), Reiter's syndrome and psoriatic arthritis, have been known for decades to associate with HLA-B27 and AAU. Particularly, 90% of patients with AS possess the HLA-B27 antigen.[2, 6]

Clinical features

Acute anterior uveitis typically presents with the patient experiencing hallmark symptoms of recent onset eye pain (often dull, aching pain) and photophobia. Secondary symptoms include blurred vision, a watery/tearing eye, redness and headache. One or both eyes may be affected. Visual acuities may or may not be reduced depending on severity of the uveitis. Pupillary testing may show a sluggish pupillary constriction response to light, usually due to iris inflammation and/or iris synechial adhesions. A direct and consensual eye pain to light is highly specific to anterior uveitis, even when other signs are not as obvious. Ocular signs include anterior chamber cells that slowly drift in the aqueous humor. These anterior chamber cells should be differentiated regionally from cells in the vitreous, which would indicate an intermediate or posterior uveitis. The clinician may often use high magnification with a relatively bright illumination upon biomicroscopy to visualize cells. The appearance of cells in the AC is similar to seeing a few to numerous dust particles floating and moving in empty space. Similarly, bright illumination and magnification is often necessary to visualize flare, with conical beam illumination revealing a Tyndall effect (light scattering) from the suspended protein particles. Severe flare and inflammatory mediators released into the anterior chamber can rarely lead to a viscous 'plasmoid' aqueous and hypopyon. The corneal endothelium may show adherent cells (both white blood cells and, less often, iris melanocytes) that predispose the inferior aspect of the cornea (Arlt's triangle). Although the eye can appear white with uveitis, circumlimbal injection is a notable sign and, less often, a more generalized conjunctival inflammation. Posterior synechiae (iris adhesions, usually at the pupillary ruff, to the anterior lens capsule) are not uncommon with anterior uveitis; one study found posterior synechiae in half of 119 patients with acute anterior uveitis, regardless if it was HLA-B27 positive or negative.[7] A corectopia (irregularly shaped pupil) can result from posterior synechiae, as well as later adhesion of pigment to the

anterior lens capsule in a circular pattern corresponding to pupillary ruff pigment (Vossius ring). A fibrin membrane on the anterior lens capsule can often remain from longstanding synechiae. Extensive posterior synechiae can lead to circumferential adhesion to the anterior lens capsule, leading to pupillary block, a bowing forward of the iris (iris bombé) from posterior aqueous entrapment, and highly-elevated intraocular pressure (IOP). Peripheral anterior synechiae (PAS), whereby the peripheral iris tissue near the ciliary body adheres to the anterior chamber angle structures, is less common. Best observed via gonioscopy, these adhesions can block the trabecular meshwork, impeding aqueous outflow and potentially elevating the IOP.

Differential diagnoses

The common differential diagnoses for AAU are summarized in Table 2, and some of the more serious conditions are discussed.

- Intermediate/posterior/panuveitis are conditions whereby uveal inflammation has progressed beyond the iris tissue. The sign of cells and/or inflammatory exudates in the vitreous is a key finding with these uveitides, and vitreal haze is often present. Because constant fluid exchange in the vitreous does not occur as it does in the aqueous, the cells and inflammatory byproducts persist and move with gravity to settle in the inferior retina (called 'snowbanking') along the pars plana. This condition of intermediate uveitis is called pars planitis, and is more common in younger individuals, with a mean age of 30.7 years (± 15.1 years). Over two-thirds of intermediate uveitis cases are idiopathic, with sarcoidosis, multiple sclerosis (MS) and Lyme disease being the relatively less common causes.[8] Posterior uveitis may present with macular edema, chorioretinal inflammation, retinal vasculitis and optic disc edema. Vitreal haze may also accompany posterior uveitis. While photophobia may be reduced in posterior uveitis (due to less inflammation of the irides), visual blur is usually more severe and prognosis of visual recovery poorer. Panuveitis involves all regions of the uvea. Photophobia, eye pain and reduced vision are usually very severe, with poorer prognosis for long-term vision.
- Endophthalmitis, a true eye emergency involving inflammation of the vitreous and aqueous humor, may present with symptoms of blurred vision, eye pain and redness and light sensitivity, similar to AAU. However, history is an important differential, as endophthalmitis can be a rare endogenous (causative source is within eye) complication from ocular infection after surgical procedures such as cataract extraction and vitreoretinal surgeries.[9,10] Exogenous (source is from outside the eye) endophthalmitis may result from infection spread from another source (i.e., endocarditis). Endophthalmitis may also occur from penetrating eye injury or ocular surgery and, in very rare instances, be due to unknown causes or present as a sterile inflammation from retained lens material after an operation or from toxic agents.[11] Usually along with similar symptoms, a layer of white blood cells may be seen settled in the inferior anterior chamber (hypopyon). Immediate referral for a vitreal tap and culturing/sensitivities is indicated for endophthalmitis, with subsequent pars plana vitrectomy and fortified topical, intravitreal and systemic antibiotic treatment.[12,13]
- Keratitis can present with similar symptoms to AAU, and the causes of keratitis may be non-infective or infective in etiology. Non-infective keratitis may be due to external sources such as ultraviolet light (i.e., photokeratitis) from arc-weld flashes or high altitude reflection sun/snow exposure, chemical insult, or from immune conditions (i.e., Thygeson's superficial punctuate keratitis). Infective keratitis may be bacterial, viral, fungal, acanthamoebic, or chlamydial/parasitic. Light sensitivity, redness, pain, and reduced vision with any of these forms of keratitis can mimic AAU. It is also possible that an anterior uveitic response is seen accompanying an infective keratitis, so treatment of both conditions may be warranted. Treatment of the non-infective keratitis may be similar to treatment of AAU (i.e., topical steroid and cycloplegic agents). With infective keratitis, however, care must be taken to determine the specific causative organism, as topical steroids have the potential reduce wound healing and the body's immune response to fight the infection. This is especially true of herpetic epithelial keratitis, where topical steroid use may worsen the condition. Patients with herpetic keratitis (particularly herpes zoster infection) may present with acute pain, redness and light sensitivity, and the clinician must look closely for signs of dendritic lesions, pustules and rashes that may identify herpetic infection. Fluorescein sodium and rose Bengal stain assessment are critical to ruling-out herpetic lesions on the cornea. Fluorescein staining may also reveal epithelial defects, infiltrates and ulcers due to other organisms. The presence of mucopurulent discharge is a diagnostic sign of bacterial or chlamydial infection. While untreated bacterial

Table 2
Differential diagnoses for anterior segment inflammation

AAU (iritis, iridocyclitis)	Keratitis (infective, traumatic/toxic, contact lens acute red eye)
Episcleritis/Scleritis	Lens-related (phacolysis/phacoanaphylaxis)
Acute angle closure glaucoma	Posterior segment disease (tumor, panuveitis)
Endophthalmitis (post operation, endogenous)	

and chlamydial corneal infections usually worsen over several hours to a few days, fungal and certain acanthamoebic infections may progress more slowly, with progression over a week or more after initial inoculation not uncommon. History of soft contact lens wear, old makeup use, water-based activities (i.e., swimming, hot tub) and vegetative injury are important in determining the diagnosis. Treatment of infective keratitis is dependent on the causative organism, and typically involves topical antibiotics (bacterial), oral antibiotics (chlamydial), topical and oral antivirals (herpetic), antimycotics (fungal) or antiamoebics (acanthamoeba).

- Patients with acute angle closure can present similar symptoms to AAU, including pain, blurred vision, halos vision, frontal headache, nausea and vomiting. Circumlimbal flush and corneal edema is often seen. Intraocular pressure (IOP) spike is an important sign to differentiate acute angle closure from AAU; however, the patient may have an IOP spike secondary to iris bombé caused by AAU. The main approach to management of acute angle closure is to reduce the IOP as quickly as possible with topical, and often oral, glaucoma medications.

Treatment options for acute anterior uveitis

Management of AAU is focused on 1) reducing the inflammation and any associated pain, redness, photophobia and visual blur; and 2) determining the etiology. The first step is achieved by several treatments:

- Sun protection

  The patient with AAU has usually determined that avoidance of bright light is to their immediate benefit. Encouragement of sunglasses, a brimmed hat, staying indoors more frequently and lowered lighting levels are good behavioral modifications during the acute symptomatic stage.

- Cycloplegics

  Cycloplegic agents are important for relaxing the iris (for comfort), breaking posterior synechiae, and stabilizing the blood-aqueous barrier by decreasing the iris surface area (preventing further cellular and exudative leakage). The main cycloplegic agents (listed from shortest maximal effect time/duration to longest) are listed in Table 3. The most popular agents used in AAU treatment are homatropine 5% (trade name: Isopto-Homatropine 5%; typical dosage igt q12hr) and scopolamine 0.25% (trade name: Isopto-Hyoscine; typical dosage igt q6hr). Atropine (trade name: Isopto-Atropine 1%; typical dosage igt q12hr) is used in more severe cases. Even though a cycloplegic's duration of action is relatively long in healthy eyes, the duration of action may be much shorter in uveitis due to the presence of increased esterases in the AC of a uveitic eye; hence more frequent dosing is needed.

- Mydriatics

  Phenylephrine 2.5% or 10% (trade name: AK-Dilate) is an adrenergic (alpha receptor) agonist used for assisting with the dilation of the pupil. It is used in-office with a cycloplegic agent for breaking recalcitrant posterior synechiae. Usually only one or two drops are instilled in the affected eye to facilitate dilation. The drug also assists in facilitating view of the vitreous and retina, to determine if there is any posterior segment inflammation.

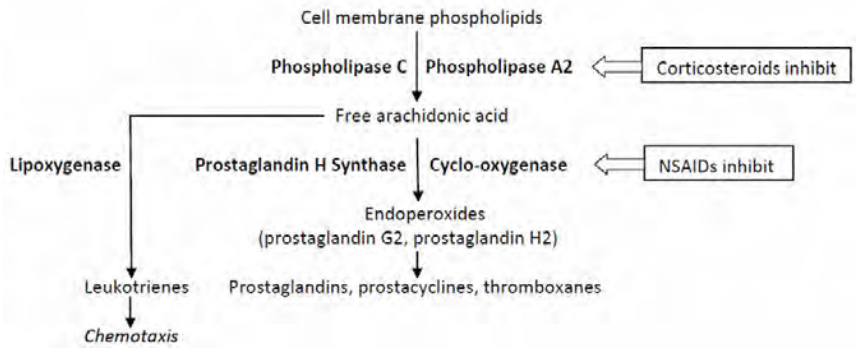
- Corticosteroids

  Corticosteroids are critical in the treatment of uveitides, including AAU. They reduce pain (including photophobia), inflammation (of most ocular tissues) and redness (of conjunctiva, episclera, limbus). Corticosteroids block the enzyme phospholipase A2 (which converts cell membrane phospholipids into inflammatory mediators such as leukotrienes and prostaglandins). This inflammatory pathway is seen in Figure 3.[14] Topical ophthalmic steroid drops can be divided into 3 main cat-

Table 3
Cycloplegic agents, their concentrations, maximal effect and duration of action in healthy eyes

Cycloplegic Agent	Maximal Effect (min)	Duration of Action
Tropicamide 0.5, 1%	20-30	3 hours
Cyclopentolate 1, 2%	20-45	1 day
Homatropine 2, 5%	20-90	2-3 days
Scopolamine 0.25%	20-45	4-7 days
Atropine 0.5, 1, 2%	30-40	1-2 week(s)

Figure 3
The cellular inflammatory pathway (enzymes labeled in bold), with points of inhibition by corticosteroids and NSAIDs (nonsteroidal anti-inflammatory drugs) shown (adapted from Samiy N et al., 1996)[14]



egories, based on clinical potency:

Minimally effective:

- dexamethasone sodium phosphate 0.05% ointment
- loteprednol 0.2% (trade name: Alrex)

Moderately effective:

- prednisolone phosphate 0.125%, 0.5%, 1% solutions
- fluorometholone 0.1% (trade name: FML Mild), 0.25% (trade name: FML Forte)
- rimexolone 1% (trade name: Vexol)

Maximally effective:

- loteprednol 0.5% (trade name: Lotemax; combined with tobramycin in Zylet)
- dexamethasone 0.1% (combined with tobramycin in TobraDex)
- 1% prednisolone acetate (trade name: Pred Forte)
- difluprednate 0.05% emulsion (trade name: Durezol)

All topical ophthalmic steroid eye drops (except for the solution prednisolone phosphate and emulsion diflurprednate) are formulated as suspensions. As such, the patient must shake the bottle vigorously before instilling the drop onto the eye, to provide a homogenous suspension of medication. The most popular steroid prescribed for AAU is Pred Forte (prednisolone 1%; igt q2hr); its generic version has been found to be less homogenous in formulation, with more shakes required for the drug to go into suspension.[15, 16] A more recent steroid on the market, difluprednate (Durezol) was shown to be as effective as Pred Forte, yet with only half the dosage of Pred Forte.[17] All steroids used over the course of a week or more are usually tapered gradually upon improvement of signs and symptoms, and then discontinued. If symptoms recur, the steroid's original dosage (or more frequent dosage) is re-initiated. Several steroid ointments (most in combination with one or more antibiotics) are also available for evening use.

Risks of topical corticosteroids include posterior subcapsular cataract (PSC) formation and elevated IOP. Usually these risks are minimal due to the short-term use of steroids in AAU treatment. Prednisolone acetate has a higher propensity to elevate IOP. Studies have shown lotoprednol 0.5% (Lotemax) to be comparable to prednisolone acetate 1% in effectively reducing anterior uveitis, yet not elevating IOP as much as prednisolone acetate.[18] Other risks of topical steroid use include reduced host immunity, stromal melt, scleral thinning and herpetic epithelial infection spread.

In certain recalcitrant uveitis cases, or when the patient is unable to properly instill eyedrops or ointment, injectable steroids may be indicated. These include regional subconjunctival or sub-Tenons injections of triamcinolone or dexamethasone, as well as intravitreal injections of each drug (Triesence; Alcon Laboratories) or implants (Ozurdex; Allergan Inc.), respectively. Fluocinolone acetate intravitreal implant (Retisert; Bausch + Lomb) is also an option in recurrent uveitides unresponsive to other steroid treatments. Unfortunately, the risk of elevated IOP and cataract with these routes of administration is much higher.[21]

- Oral steroids such as prednisone (Orasone, Deltasone, Meticorten, Sterapred, other trade names) and methylprednisone (Medrol, other trade names) are indicated when an AAU is severe or when posterior ocular involvement is seen. Typical adult dosage is 1mg/kg body weight, with taper upon improvement and dependent on duration of treatment (longer tapers with longer treatments). Along with increased IOP and posterior subcapsular cataract risk, several other potential side-effects include, but are not limited to:
  - Hypertension
  - Hyperglycemia
  - Psychosis
  - Edema (Cushing's Syndrome)
  - Osteoporosis
  - Growth suppression
  - Reduced immunity (infections)
  - Hypothalamus-Pituitary-Adrenal (H-P-A) axis suppression
  - Menstruation problems

  Because of these risks, the use of oral steroids should be weighed with the potential side-effects.
- NSAIDs

  Both oral and topical ophthalmic non-steroidal anti-inflammatory drugs (NSAIDs) have limited effectiveness in treating active AAU, as their mechanism of action inhibits the enzyme cyclo-oxygenase (which produces prostaglandins) but not the enzyme phospholipase A2 (which produces leukotrienes, responsible for attracting white blood cells into the anterior chamber via chemotaxis). However, one study showed a 66.8% reduction in recurrences of HLA-B27-associated uveitis over a 3-year period with chronic oral NSAID use.[20]
- Immunomodulators

  In cases of non-infectious AAU that is recalcitrant or non-responsive to steroid treatment, immunomodulation may be necessary. The effectiveness of these medications with uveitis has been demonstrated in several cases.[21,22] These consist of immunosuppressants and biologics. The three main immunosuppressant drug categories are:
  - Antimetabolites (methotrexate, mycophenolate, azathioprine)
  - T-cell suppressors, aka calcineurin inhibitors (cyclosporine, voclosporin, tacrolimus)
  - Cytotoxic agents, aka alkylating agents (cyclophosphamide, chlorambucil)

  Biologics, a relatively newer class of drugs, are comprised of recombinant cytokines and monoclonal antibodies directed against selected cell-surface markers.[23] The main biologics are:
  - Tumor necrosis factor-alpha inhibitors (infliximab, adalimumab)
  - Anti-lymphocyte drugs (ritux-

imab, alemtuzumab)
- Interleukin-2 receptor blocker (daclizumab)
- Recombinant interferon-alpha

Both immunosuppressants and biologics often take several weeks to achieve efficacy.

- Surgery

  Surgical treatment for AAU is rare and only indicated in severe cases where secondary complications arise. Permanent structural changes from uveitis that may require surgical management include cataract formation, secondary glaucoma due to pupillary block or angle closure, and retinal detachment. Surgical indications include restoring visual clarity, diagnostic biopsy, or removing media opacities to monitor the posterior segment. Surgical procedures include, but are not limited to: extracapsular phacoemulsification/cataract extraction, iridotomy/iridectomy, filtering surgeries, vitrectomy and other corneal and retinal procedures.

Discussion

Uveitis is an inflammatory disease of the eye, potentially responsible for up to 20% of all blindness.[24] The International Uveitis Study Group (IUSG) and Standardization of Uveitis nomenclature (SUN) Working Group have adopted a classification of uveitis according to anatomical location: anterior (anterior chamber), intermediate (ciliary body, vireous), and posterior (retina, choroid), with panuveitis involving all locations.[25,26] Acute anterior uveitis (AAU) is an ocular presentation that has many potential etiologies. Identification of the key clinical findings of AAU – cells and flare – along with the accompanying symptoms of pain and photophobia - has been documented in the literature for over half a century.[27] While the most common etiology of anterior uveitis is idiopathic (38-70%), the next most-common etiology is HLA-B27-positive, particularly with acute-onset forms.[4] HLA-B27 is present in 1.4-8% of the general population; however, it can be present in between 50-60% of patients with AAU.[3] Since HLA-B27-positive results are strongly related to ankylosing spondylitis and other connective tissue disorders, questions regarding joint and back problems, pain on urination or stomach irritation, arthritis, or other autoimmune diseases (i.e., Reiter's syndrome, inflammatory bowel disease, psoriatic arthritis, and post-infectious arthritis) should be asked in the history, along with the patient's current medication list. Other causes of AAU may include trauma and herpetic infection. Less common potential infective etiologies include syphilis, tuberculosis, toxoplasmosis and Lyme disease.[4] Table 4 summarizes the common causes of acute and chronic anterior uveitis.

The management of uveitis is strongly achieved through an evidence-based approach. No standard laboratory evaluation for uveitis exists, except for determining syphilis and possibly sar-

Table 4
Common causes of acute and chronic anterior uveitis (adapted from McCannel et al., 1996)[4]

Acute Anterior Uveitis	Chronic Anterior Uveitis
HLA-B27 positive (uveitis only) Ankylosing spondylitis Reactive arthritis (Reiter's) Psoriatic arthropathy HLA-B27 negative (idiopathic) Sarcoidosis Behcet's disease Posner-Schlossmann Syndrome Crystalline lens-associated Syphilis Lupus Trauma	Juvenile idiopathic arthritis (JIA) Fuch's heterochromic iridocyclitis Idiopathic Sarcoidosis Syphilis Lupus Herpes (zoster/simplex)

Table 5
Review of systems via history with uveitis-associated diseases (adapted from Cheng et al., 2005 and Gutteridge et al., 2007)[3,27]

System	Diseases
Dermatological	Psoriasis, syphilis, sarcoidosis, lupus, herpes simplex/zoster, Behcet's disease
Gastrointestinal	Inflammatory bowel disease
Genito-urinary	Reiter's syndrome, Behcet's disease, syphillis
Respiratory	Sarcoidosis, tuberculosis
Rheumatological	Spondyloarthropathies (eg., alkylosing spondylitis)

Table 6
Systemic diseases with uveitis association and corresponding lab tests (adapted from Cheng et al., 2005)[3]

Diseases	Clinical Features	Laboratory tests
HLA-B27 positive	Uveitis only	HLA-B27
Ankylosing spondylitis	Lower back pain, worse in a.m.	HLA-B27, ESR, spinal X-ray
Reiter's syndrome	Triad: arthritis, urethritis and conjunctivitis	HLA-B27, ESR, ANA
Arthritis, psoriasis	joint pain, skin inflammation	HLA-B27, joint X-rays
Inflammatory bowel disease	Bloody diarrhea & abdominal cramp	HLA-B27, endoscopy
Behcet's disease	Aphthous mouth/genital ulcers	HLA-B5
Multiple sclerosis	Optic neuritis, CNS plaques	Cranial MRI, HLA-DR2
Sarcoidosis	African ethnicity, shortness of breath, skin nodules	ACE, lysozyme, chest X-ray, gallium scan, biopsy

coidosis-based etiologies. In addition, many laboratory tests have false-negative or false-positive results that may potentially confuse the clinical picture and/or contribute to erroneous diagnoses, along with an additional cost burden.[28] Careful history and physical examination related to the review of systems (i.e., dermatologic, hematologic, respiratory, circulatory, neurological, ear/nose/throat, constitutional, etc.) often is more valuable to determining the cause of the uveitis (Table 5).[29] Physical signs such as the presence or absence of granulomatous nodules or keratic precipitates (KPs) also assist in discriminating autoimmune (i.e., sarcoid, systemic lupus erythematosis) from non-autoimmune-based uveitis.[30]

When AAU is severe, unresponsive to treatment, persists or recurs, laboratory testing may be necessary (Table 6). Minimum lab tests (with key identifiable disease examples in brackets) may include: HLA-B27 (ankylosing spondylitis), urinalysis (psoriatic arthritis), angiotensin converting enzyme (ACE) (sarcoidosis), venereal disease research laboratory aka VDRL and fluorescent treponemal antibody aka FTA-ABS (syphilis) and chest X-ray (tuberculosis, sarcoidosis). In certain cases, anterior chamber or vitreal taps, culture swabs or tissue biopsies may be indicated. One clinical study made evidence-based recommendations for appropriate tests in four anterior uveitis situations:[31]

- Non-granulomatous anterior uveitis in an adult: HLA-B27
    - If recurrent or chronic: chest X-ray, VDRL and FTA-ABS
- Granulomatous anterior uveitis in an adult: chest X-ray, purified protein derivative (PPD) tuberculin testing, serum ACE levels, VDRL and FTA-ABS
- Granulomatous anterior uveitis, suspected sarcoidosis, in an adult or child: chest X-ray, ACE
    - If suspicion is high despite these tests normal: High-resolution computerized tomography (HRCT) scan of the chest or whole body gallium scan with or without biopsy
- Anterior uveitis in a child: Antinuclear antibody (ANA), HLA B-27

Some lab tests, such as complete blood count (CBC), erythrocyte sedimentation rate (ESR), and rheumatoid factor (Rf), have been regarded as too non-specific for diagnostic purposes in anterior uveitis, and only play only an adjunct role in certain cases.[32] The clinician must balance the diagnostic value with cost-effectiveness when ordering laboratory tests (Table 6).

Conclusion

This article highlights two cases of acute anterior uveitis (AAU), their clinical management and course. While the hallmark signs and symptoms of AAU are highly diagnostic, the pathogenesis and etiology may be elusive. A careful evidence-based methodology, including detailed case history and review of systems, physical examination and potential laboratory testing, is necessary for effective diagnosis and management. Treatment is initially focused on reducing the inflammatory findings, with the goals of improving patient comfort and visual function. Once a more detailed etiology of the AAU is determined, treatment is then also geared towards the cause.

Throughout the care of the patient with AAU, it is important to educate the patient thoroughly regarding his/her condition, the possible causes and prognosis. Following this, discussion of the various treatment options and initiation of treatment should begin immediately, with close monitoring (i.e., daily or every few days, depending on the severity of the presentation). Judicious yet effective dosage of topical corticosteroid and cycloplegic agents are the mainstay of AAU treatment. Depending on the presentation and cause, other medications, lab tests and tertiary procedures may be necessary. Finally, coordination with other specialists (i.e., ophthalmologists, rheumatologists) may be critical in diagnosis and treatment. Eye care providers play a key role in the interdisciplinary management of the patient with AAU.

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