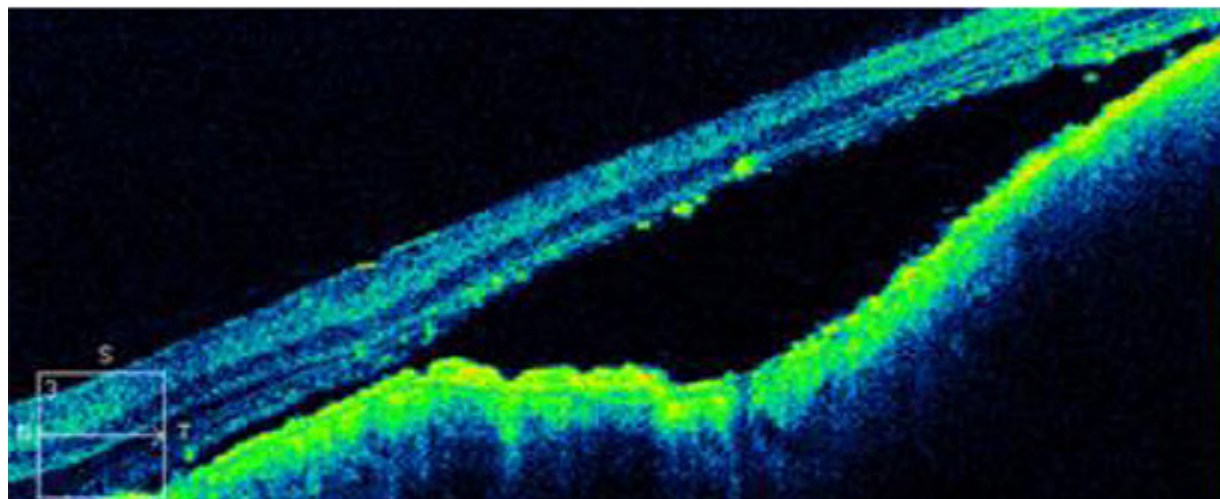


Optometric Education: Volume 42 Number 3 (Summer 2017)

OPTOMETRIC EDUCATION

The Journal of the Association of Schools and Colleges of Optometry

Volume 42, Number 3
Summer 2017



Vitamin B12 Deficiency Optic
Neuropathy: a Teaching Case Report

Influence of Participation in an
Elective Course in Enhancing
Perceived Critical Thinking,
Independent Learning and Residency
Decision-Making

Normotensive Glaucoma Follow-Up
with Incidental Finding of Choroidal
Neovascular Membrane: a Teaching
Case Report

Choroidal Melanoma and Disclosing Bad
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Communicating Educational Objectives in an
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Winners of the 2017 Dr. Lester Janoff Award for Writing
Excellence

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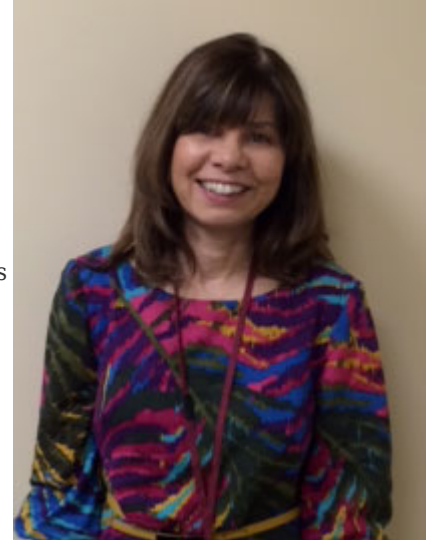
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Why Tenure is Important

Aurora Denial, OD, FAAO | Optometric Education: Volume 42 Number 3 (Summer 2017)

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The American Association of University Professors (AAUP) defines a tenured appointment as “an indefinite appointment that can be terminated only for cause or under extraordinary circumstances”¹ The AAUP further defines tenure as “a means to certain ends; specifically: (1) freedom of teaching and research and of extramural activities, and (2) a sufficient degree of economic security to make the profession attractive to men and women of ability.”² The AAUP has been involved with setting standards and guidelines for higher education since 1915. In the late 19th century and early 20th century, faculty members were at risk of being terminated for teaching or voicing views that may not have been in agreement with the institution’s administrators or board of trustees. As faculty members, we all have a responsibility to advance, transmit, disseminate, interpret and apply knowledge. Academic freedom in research and teaching allows educators to fulfill their responsibilities without the threat of retaliation. Tenure with the goal of academic freedom has impact on student learning, society and the advancement of a profession or discipline.



In 1940, the AAUP and the Association of American Colleges and Universities jointly formulated the *Statement of Principles on Academic Freedom and Tenure*. This standard for tenure has been widely adopted by colleges and universities.¹ The standard includes a probationary period of usually seven years before the final tenure decision.³ Denial of tenure at some institutions can lead to a terminal contract. The criteria for tenure vary among institutions and are usually demanding, requiring excellence and significant accomplishments in scholarly activities, teaching and service. Usually faculty set the criteria for tenure with approval from the governing administration or board of trustees. In addition to excellence and significant accomplishments, momentum for continued productivity throughout a faculty member’s career is also taken into consideration. Securing tenure brings rewards of academic freedom and due process. However, it also brings a moral obligation of collegial support, a high level of performance and productivity.

No Shortage of Debate

Debates about the merits of tenure are plentiful in the literature. Some of the arguments against tenure are the potential of publishing insignificant research just to acquire a sufficient number of publications, negative consequences of a “job for life,” and the creation of a divide among faculty members. Negative consequences of a “job for life” might include, over the course of a career, decreased productivity or motivation for scholarship, teaching or service-related activities. However, tenure does not ensure a job for life. Tenure ensures that due process is followed in the event of termination. Termination of a tenured professor usually occurs with evidence of incompetence, unprofessionalism or extenuating circumstances such as significant financial exigency.¹

Arguments supporting tenure include the potential for increased ability to recruit and retain faculty members, academic freedom, job security and a higher level of productivity. The culture of academia supports the concept of tenure in higher education and optometric education. The Association of Schools and Colleges of Optometry (ASCO) reports that 19 out of the 23 member optometry schools in the United States and Puerto Rico offer tenure to optometric faculty.⁴

Tenure is Preferable to Long-Term Contracts

Within an institution, administrators come and go, and every four years a new cadre of students enrolls, but the faculty represent the mainstay of the educational process. The faculty at most institutions is comprised of many unique individuals all contributing important skills and talents to create a sustainable learning environment. Each faculty member of an institution is integral to the educational process and valuable. ASCO reports that of the 638 full-time optometric faculty, 223 (35%) are tenured, 107 (16.8%) are in the tenure track, and 308 (48.3%) are not in the tenure track.⁴ The tenured faculty can offer continuity and stability to an institution. Academic freedom allows faculty to take risks and think outside the box. Furthermore,

it allows a system of checks and balances, whereby faculty have the opportunity to evaluate and challenge academic and administrative policies. Job security and the assurance of due process are reassuring to faculty and therefore have the potential to increase productivity.

From my observations, the tenured faculty form a core group of faculty who are dedicated, hardworking and successful. Their expertise and experience support them as leaders and mentors for the institution and the profession. To reach high educational standards and maintain quality for future generations of students and faculty, we need to support the stability and productivity of the tenured faculty.

The argument has often been made to replace tenure with long-term contracts. Although at some institutions long-term contracts can be a viable option, these contracts do not necessarily protect a faculty member from a lack of due process upon termination or safeguard academic freedom. Additionally, the intrinsic motivation to be successful and the sense of accomplishment in achieving tenure may be missing in long-term contracts.

In 2009, I achieved tenure status. This accomplishment came with an enormous sense of responsibility. I viewed it as an acknowledgement of my accomplishments and the ultimate compliment. My institution believed in me enough to grant me this status; therefore, I needed to be more productive than previously, an exemplary role model and an even stronger advocate and supporter of the college.

Why is tenure important? To answer this question I asked myself: Would I be comfortable writing this editorial if I were not a tenured professor?

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A Digital Means to an Analog End?

Paul M. Dobies, OD, FAAO | Optometric Education: Volume 42 Number 3 (Summer 2017)

[PDF of Article](#)

The previous issue of *Optometric Education* included a thought-provoking editorial titled “Do Students Still Need to be Proficient in Gathering Data?”¹ Before I share my thoughts in response, I acknowledge that our individual experiences inform our biases and our judgments. In the years prior to joining the faculty at Western University of Health Sciences, I practiced full-time with ophthalmologists providing primary and secondary medical and surgical eye care. In those settings, 75% of my patients were age 75 or older, which is hardly a standard optometric patient population. However, 100,000 patients later, the experiences had prepared me to be a full-time clinical educator. From this non-standard perspective, I offer the following response.

- **Patients are human beings and human beings are analog.** It’s true that our individual neurons fire “all or nothing” in “digital” fashion. However, spending as much time as I did with a senior patient population I saw that rather than becoming more similar to one another with the passing of time, people become more different from one another as they age, and the range of analog human experience and expression can be truly breathtaking if we take the time to notice. In other words, as we age, we become more “analog” in terms of the rich variations of human experience and less “digital” in terms of information approximations.
- **Digital is an approximation of analog.** Digital contains less information than analog. For example, each currently available digital refractor has its own quirks that make binocular testing of analog human beings less than ideal. Also, for example, the best digital laser full-field retinal images are decidedly less nuanced than my own eyes and cannot substitute for a full-field BIO evaluation. Digital images in no way communicate subtle differences let alone expand my ability to see them with my analog BIO-enhanced eyes. Digital images can document what my analog eyes see but not with the same resolution or nuance. Showing someone a digital picture of your favorite vacation spot cannot substitute for, much less expand upon, what your human analog eyes saw being there.
- **Visual testing is subjective and requires two analog human beings: a patient and a provider.** The eyes are not separate entities. Myriad interconnections between them create something akin to a miracle as we experience human analog binocular vision. On the other hand, digital autorefractors are actually autoretinoscopes. Granted, I have seen autorefractors identify cylinder power and axis in some senior patients better than I can with my retinoscope, but even the best autorefractor cannot match what I can see with a retinoscope in a dynamic way, such as accommodative stability, pupil size changes and media changes. Additionally, other than its sanguine 0.12D measurement markings, an analog keratometer provides tear film assessment and central and peripheral corneal distortions in addition to the opportunity to notice other nonverbal clinical clues in a dynamic way vs. a static moment-in-time digital autokeratometry measurement.
- **In daily primary care optometric practice, an analog approach to data-gathering provides more information about patients, most of whom have normal eyes.** The return-on-investment of expensive digital equipment for an essentially normal patient population is certainly low-yield for most entry-level graduates. To put it another way, just because we educate students medically and just because expensive digital equipment is available doesn’t mean that an essentially normal patient population is going to change (even with the aging of the Baby Boomers) commensurate with provider cost and actual patient need, unless, of course, one practices in an area with a greatly elevated proportion of seniors.



Paul Dobies, OD, FAAO

I enjoyed using all of the digital equipment I had access to as I worked with my senior patients who were “normally abnormal.” I used the technologies routinely to document (and occasionally find) what my analog eyes were seeing (or suspecting) in the course of data-gathering via physical exam. But other than the “show biz” factor, as I said, digital imaging of normal patients is decidedly low-yield. In most cases, the analog human eye, when trained, can identify when digital documentation is needed for patient diagnosis, treatment and management.

Therefore, I venture to say, we should focus on patients first and guard against attempting to see more patients in less time with standardized digital equipment. Because both patients and providers are analog human beings first, we should guard against “outsourcing” an actual physical exam, only to obtain less information, in an era when both patients and providers are seeking more individualized care and stronger interpersonal and interprofessional communication. Human analog vision care takes time. Call me “old school,” but I advocate working together to discover how digital equipment can free up more time

as a means to the truly human analog end of improved quality face-to-face vision care.

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1. Denial A. Do students still need to be proficient in gathering data? Optometric Education [Internet]. Winter-Spring 2017 [cited 2017 June 22];42(2). Available from: <https://journal.opted.org/article/do-students-still-need-to-be-proficient-in-gathering-data/>.



The SUNY Hackathon Series: Redesigning 21st Century Eye Care

Thomas A. Wong, OD | Optometric Education: Volume 42 Number 3 (Summer 2017)

[PDF of Article](#)

In May and November 2016 and June 2017, approximately 50 people met to participate in three hackathons hosted by the New Technologies unit of the State University of New York College of Optometry (SUNY). The participants included SUNY Optometry faculty, other optometrists, residents, students, alumni, researchers, industry experts and other professionals.

The goal of Hackathon I was to design “The Future Eye Exam.” Participant groups were given the task of creating a six-minute presentation to the National Eye Institute on how eye examinations should be conducted. Hackathon II centered on “The Future of Optometric Education.” Participant groups were asked to design a mobile app to be used for optometric student/intern/resident education, optometric continuing education and optometric board certification review. Zoom video conferencing technology was utilized, which allowed Munish Sharma, MD, OD, FAAO, from Western University of Health Sciences and Andre Stanberry, OD, from the University of Waterloo to participate. Their universities are intellectual partners with SUNY in designing and implementing a mobile app for optometric education. The focus of Hackathon III was Interprofessional and it was a collaboration with the nursing profession. It tasked participants with creating new models of communicating with patients, parents and families to convey the importance of vision in the learning process. Participants and speakers included Beth Matthey, President of the National Association of School Nurses, and Ashley Darcy Mahoney, PhD, RN, NNP-BC, who spoke about “Talk With Me Baby,” a program that President Obama had discussed at the Early Education Summit.



Thomas A. Wong, OD

Why a Hackathon Series?

The SUNY Optometry New Technologies unit created its signature Hackathon Series to develop new models of patient care, education and communication with the goal of improving patient outcomes. Hackathons are digital-era tools designed to connect participants for the purpose of breaking down existing processes into discrete and new units, and rebuilding them from the ground up. The word “hack,” when used as a noun, means a change, tweak or solution to a problem. When used as a verb, hack means to redesign or remix a product or solution to make it better. Thus, the term hacking refers to taking something apart and rebuilding it to make it better, give it a new function, or just do something surprising and disruptive. A hackathon is an event where participants “hack” on a problem or focus area for an allotted period of time, with the goal of building or creating a solution (via a product, service, tool, etc.) Hackathons seek to identify opportunities by understanding the user’s experience. Ideas + Action = Hackathon. Hackathons generally start with an overview presentation and end with a series of short presentations that are judged on several categories, e.g., innovation, ability to be implemented and quality of presentation. Prizes, which include sunglasses, T-shirts, notebooks, backpacks and smartphone chargers, have been awarded to all participants. The winning teams’ proposals serve as the initial template to be incubated within the SUNY Optometry New Technologies unit.

The SUNY Optometry New Technologies Hackathon Series is modeled after Georgetown University’s “Hackathon: Designing the Future University from the Inside.” Also, organizational concepts were derived from Stanford University’s “Collaborative Stanford-Centered Hackathon Experience,” and MIT’s “Hacking Medicine Series.” Prior to each SUNY hackathon, participants were sent TEDx videos on innovation, creativity and new concepts in education. Participants were encouraged to move away from the linear, analog thinking that has been the basis of education since the Industrial Revolution, and toward digital learning processes that are important for success in the new millennium. Digital learning processes are important for utilization of new technologies in medicine and eye care. It’s important to note that the SUNY New Technologies unit is not promoting digital, online exams. Quite the contrary, we maintain that digital learning processes are integral to improved time efficiency and quality improvement in professional optometric care.

Information from Hackathons II and III is still being studied and reviewed. These themes emerged from Hackathon I: The Future Eye Exam:

1. an integrated patient portal for online case histories, clinic hours and information, patient education, insurance verification, answers to patient questions, referrals, etc.
2. use of wavefront aberrometry for refraction and diagnosis
3. use of wide-angle fundus photography and similar technology as a screening procedure
4. use of automated visual acuity technology allowing for contrast sensitivity evaluation and real-world simulation
5. use of virtual and augmented reality simulations
6. delegation of data collection to technicians, with optometrists performing data interpretation
7. use of cloud-based services for biomedical informatics

Hackathons Aren't Just for "Techies"

Hackathons are no longer just for computer programmers and engineers at internet companies — not just for techies! They are events increasingly used by major universities, state and federal governments, non-profit organizations, hospitals, architectural and engineering companies, and so on. We live in a connected world with no boundaries. Mobile health applications have been at the core of medical education for well over a decade. For our optometric profession to advance and fulfill its critical role in the delivery of health care, we need to utilize innovative technologies to improve patient outcomes and educate optometrists, optometric faculty, residents and students. Moreover, the ability to utilize innovative technology to enhance interprofessional relationships and integrate culturally competent care is essential to achieving the best possible results for our patients.



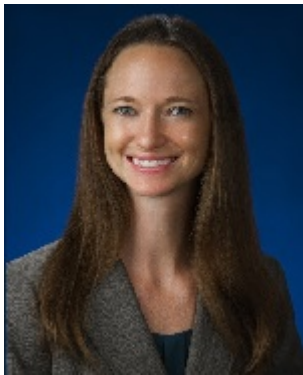
Journal Bestows 2017 Writing Excellence Award

| Optometric Education: Volume 42 Number 3 (Summer 2017)

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Gregory Fecho, OD



Jamie Althoff, OD



Patrick C. Hardigan, PhD

Gregory M. Fecho, OD, Jamie Althoff, OD, and Patrick Hardigan, PhD, all faculty members at NOVA Southeastern University, received the 2017 Dr. Lester Janoff Award for Writing Excellence for their research paper “[Assessing Student Performance in Geometrical Optics Using Two Different Assessment Tools: Tablet and Paper](#),” which was published in the Fall 2016 (Volume 42, Number 1) issue of ASCO’s journal *Optometric Education*. The award, presented every two years by ASCO, recognizes writing excellence based on significance of the research article topic, quality of the article and potential impact. A committee of the journal’s Editorial Review Board chooses the winner from among all of research articles that had appeared in *Optometric Education* in the previous two years.

The award is given in honor of the late Lester Janoff, OD, MSED, FAAO, who served as editor of the journal from 2002-2005 and a long-time member of the Editorial Review Board. Dr. Janoff was known as an exceptional optometric educator, administrator, contact lens clinician and researcher. He was also a beloved mentor of young writers.



Vitamin B12 Deficiency Optic Neuropathy: a Teaching Case Report

Amber R. Scharnweber, OD, FAAO, ABCMO, and Richard J. Zimbalist, OD, FAAO | Optometric Education: Volume 42 Number 3 (Summer 2017)

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Background

Vitamin B12 (also known as cobalamin) is an essential vitamin for neurological function. Vitamin B12 deficiency optic neuropathy is a rare complication of this deficiency that results in progressive, bilateral, painless vision loss that is often associated with reduced color vision and central or cecentral scotomas. The following case report discusses the diagnosis and management of vitamin B12 deficiency optic neuropathy and is appropriate as a teaching guide for third- and fourth-year optometry students as well as optometry residents. The case report explores multiple facets of vitamin B12 deficiency including pathogenesis, epidemiology, manifestations, differential diagnosis and treatment modalities. The role of the optometrist in managing this condition to optimize visual recovery is also highlighted.

Case Description

A 63-year-old Caucasian male presented to the eye clinic for a second opinion regarding cataract surgery in February 2011 following a gradual decline in his vision over the previous two months. He received new glasses from a private provider in December 2010 but continued to experience decreased visual acuity. He was also referred to a private ophthalmologist for cataract surgery, but the procedure was not performed as it was believed that the lenticular changes were not the primary etiology of his visual loss.

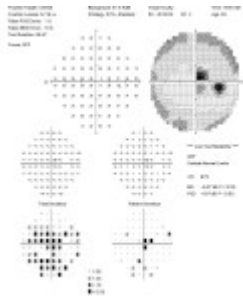


Figure 1A. SITA Standard 30-2 Humphrey Visual Field testing from the initial visit in February 2011 shows central scotoma OD.
[Click to enlarge](#)

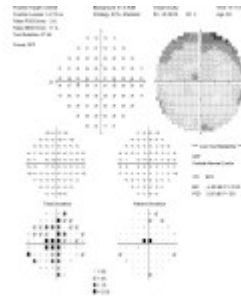


Figure 1B. SITA Standard 30-2 Humphrey Visual Field testing from the initial visit in February 2011 shows central scotoma OS.
[Click to enlarge](#)

The patient's medical history was positive for obesity, nicotine dependence, gouty arthropathy, mild carotid artery stenosis, throat cancer and stomach ulcer. He was status post a December 2004 resection of an oropharyngeal tumor and neck dissection. The stomach ulcer was treated with gastric surgery, date unknown, with resultant pernicious anemia. His current medications included allopurinol 100 mg daily, cyanocobalamin 1000 mcg/mL intramuscularly monthly, folic acid 1 mg daily, and aspirin 81 mg daily. He had an allergy to hydrochlorothiazide, which caused hyponatremia. The patient denied alcohol and recreational drug use. His family history was unremarkable. Recent blood pressure was normotensive at 121/80 mmHg (left arm, sitting) and his calculated BMI was 30.78. Ocular history was only remarkable for recently diagnosed cataracts. The patient was oriented to time, place and person, and his mood and affect were appropriate.

The patient's entering aided visual acuities were 20/400 OD and 20/400 OS at distance. His current prescription measured OD: +1.75 DS and OS: +2.00 -0.50x049. Pupils were equally round and reactive to light, without an afferent pupillary defect. Extraocular muscles were full without restriction. Confrontation visual fields were full to finger count OD and OS without extinction. Cover test was orthophoric at distance. Subjective refraction was OD: +2.00 DS and OS: +2.00 DS. The subjective refraction did not improve the best-corrected visual acuities. The patient was able to see only the test plate on color vision testing with Ishihara plates OD and OS.

Anterior segment evaluation was unremarkable except for 1+ nuclear sclerotic lenticular opacities in both eyes. Intraocular pressures as measured by Goldmann tonometry were 16 mmHg OD and 16 mmHg OS.

Dilated fundus examination showed distinct, flat optic nerves with cup to disc ratios of 0.5 OD, 0.5 OS and mild temporal optic nerve head pallor in both eyes. The maculae were flat with even pigment, and a positive foveal light reflex was noted in both eyes. The rest of the posterior segment was unremarkable OU.

SITA Standard 30-2 Humphrey Visual Field (HVF) revealed central scotomas OD and OS; however, testing was somewhat unreliable due to fixation losses. The mean deviations were -6.07 dB OD and -4.90 dB OS. **(Figure 1)** Optical coherence tomography (OCT, Stratus) macular testing was normal, but the scans were off-center with poor signal strength. Retinal nerve fiber layer (RNFL) evaluation with OCT revealed a small wedge of temporal thinning OD and was unreliable OS. The OCT scans were less than optimal due to poor patient fixation and technique.

TABLE 1
Lab Results

Date	Lab Test	Result	Units	Reference Range	Flag
10/19/2010	WBC	6.5	K/mm	4.0-11.2	
	RBC	3.21	M/mm	4-5.9	L
	HGB	11.1	g/dL	13-17	L
	HCT	34	%	37-51	L
	MCV	105.9	fmu	81-99	H
	MCH	34.6	ug	27-33	H
	MCHC	32.6	gm/dL	32-36	
	RDW	16.7	%	12 thru 15	H
	PLT	431	K/mm	130-400	H
	Iron	247	ug/dl	46-186	H
	Iron Sat	89	%	14-50	H
	MMA	145	nmol/L	87-318	
12/15/2010	B12	98.1	pg/mL	140-800	L
	RBC Folate	197.4	ng/mL	252.6-814.7	L

Table 1.
[Click to enlarge](#)

An in-depth chart review revealed that the patient had been diagnosed with vitamin B12 deficiency in October 2010 as a result of routine bloodwork. **(Table 1)** At that time, he was prescribed vitamin B12 1000 mcg po daily and folic acid 1 mg po daily. The patient's primary care provider consulted hematology, and treatment was amended in January 2011 to intramuscular cyanocobalamin 1000 mcg/mL once weekly for four weeks and monthly thereafter to be followed by folic acid 1 mg daily po. This change was recommended because incompletely treated vitamin B12 deficiency with oral replacement by folic acid can aggravate the neurological impairment related to B12 deficiency if the B12 is not corrected first. The goal was to ensure vitamin B12 was bioavailable in the presence of any malabsorption issues the patient may have had secondary to the previous gastric ulcer surgery.

The patient was diagnosed with bilateral optic neuropathy due to vitamin B12 deficiency. Magnetic resonance imaging (MRI) of the brain and orbits was ordered to rule out other neurological etiologies.

Follow-up 1: one month after initial presentation

The patient reported his vision was stable. He continued to receive cyanocobalamin 1000 mcg/mL intramuscularly. The MRI of the brain and orbits was unremarkable. His best-corrected visual acuity remained 20/400 OD and 20/400 OS and he was only able to see the test plate of the Ishihara color vision test OD and OS. The patient refused repeat HVF testing at this visit. Repeat RNFL OCT testing revealed stable temporal thinning OD and was unreliable OS. The plan was to continue intramuscular supplementation with cyanocobalamin.

Follow-up 2: five months after initial presentation



Figure 2.
[Click to enlarge](#)

The patient reported his vision had improved slightly since his last exam. He continued to receive cyanocobalamin 1000 mcg/mL intramuscularly. His best-corrected visual acuity improved to 20/80 OD and 20/80-2 OS. His color vision had also improved to 2/8 OD and 4/8 OS with Ishihara plates. HVF SITA Fast 24-2 revealed improved central defects with mean deviation OD: -1.57 dB and OS: -2.65 dB. **(Table 2)** Visual field testing was modified to the shorter 24-2 to improve patient cooperation.

TABLE 2
Indices Following Treatment of Vitam

	Visual Acuity	MD of Visua
	20/400	-6.07
	20/400	-4.90
	20/80	-1.57
	20/80-2	-2.65
	20/40	-0.79
	20/80	-2.87

Table 2.
[Click to enlarge](#)

Follow-up 3: nine months after initial presentation

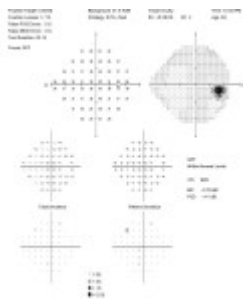


Figure 3A. SITA Standard 24-2 Humphrey Visual Field testing OD from the patient's final visit in November 2011 shows a clear visual field.
[Click to enlarge](#)

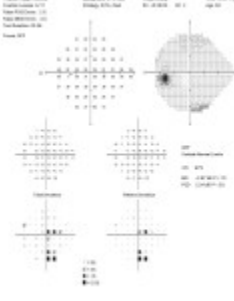


Figure 3B. SITA Standard 24-2 Humphrey Visual Field test results OS from the patient's final visit in November 2011. Note the improvement in the central scotoma compared with initial testing as seen in both the threshold and pattern deviations.
[Click to enlarge](#)

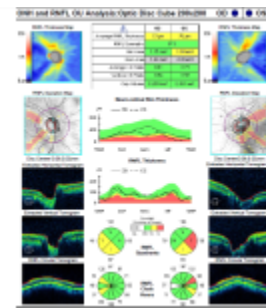


Figure 4. Cirrus HD-OCT RNFL imaging from Nov. 10, 2011 (10 months after the change in therapy by hematology).
[Click to enlarge](#)

The patient continued to report visual improvement and was able to get his driver's license reinstated. He continued to receive cyanocobalamin 1000 mcg/mL intramuscularly, and his serum B12 and folate levels had noticeably improved from baseline.

(Figure 2) His best-corrected visual acuity was 20/40- OD and 20/80- OS. His color vision had improved to 5/8 OD and remained stable at 4/8 OS with Ishihara plates. HVF 24-2 testing revealed a clear visual field OD and a stable central scotoma OS. **(Figure 3)** Mean deviations were OD: -0.79 and OS: -2.87. RNFL OCT testing (Cirrus HD-OCT 4000) revealed temporal and inferior thinning OD and OS. **(Figure 4)** It was also noted that the patient had developed a posterior subcapsular cataract in his left eye. The fundusoscopic views of the left eye were decreased consistent with the cataract formation, thus the cataract was likely also limiting the patient's best-corrected visual acuity. The patient was instructed to continue the cyanocobalamin injections and return in six months for follow-up. Unfortunately, he passed away in February 2012. The cause of death was unknown.

Education Guidelines

Key concepts

1. Understand the systemic causes of vitamin B12 deficiency
2. Understand the systemic and ocular manifestations of vitamin B12 deficiency
3. Recognize the additional testing necessary to identify the cause of optic neuropathy and the importance of reviewing the medical record and history
4. Understand the treatment of vitamin B12 deficiency
5. Understand the importance of collaborating with other health professionals in managing vitamin B12 deficiency optic neuropathy
6. Understand the need to investigate further if the clinical picture does not match the best-corrected visual acuity

Learning objectives

At the conclusion of this case discussion, participants should be able to:

1. Describe the ocular presentation of toxic/nutritional optic neuropathy
2. Describe additional testing that can be performed to confirm the diagnosis of optic neuropathy
3. Understand the pathogenesis of vitamin B12 deficiency optic neuropathy
4. Describe treatment and team management for vitamin B12 optic neuropathy
5. Identify differential diagnoses that can present with similar findings to B12 deficiency optic neuropathy

Discussion questions

1. What are the demographics of vitamin B12 deficiency and vitamin B12 deficiency optic neuropathy?
2. What are the classic systemic signs and symptoms of vitamin B12 deficiency?
3. What is the ocular presentation of vitamin B12 deficiency?
4. What are the differential diagnoses for vitamin B12 deficiency optic neuropathy?
5. How is vitamin B12 deficiency optic neuropathy treated?
6. Why is it important to treat vitamin B12 completely before supplementing with oral folic acid?
7. What is the visual prognosis and limitations for visual recovery from vitamin B12 deficiency optic neuropathy?

8. How would you further evaluate the effect of cataract on a patient's best-corrected visual acuity?
9. How could this case have been handled differently?

Learning assessment

1. Facilitate case discussion to achieve learning objectives
2. Clinical skills can be tested via practicum of visual field, OCT and fundus photography
3. Knowledge base can be assessed by comparison of normal and abnormal visual fields, OCTs, fundus photos and MRI
4. Knowledge base can be assessed by student presentations of differential diagnoses or written theoretical case examples

Discussion

Vitamin B12 is one of eight components of the vitamin B complex. It plays a key role in DNA synthesis, maintaining normal brain function, protein metabolism and erythropoiesis.¹ The best sources of vitamin B12 are eggs, milk, cheese, meat, fish, shellfish and poultry.^{1,2} The recommended daily requirement is 6-9 mcg. Most individuals in developed countries consume this amount. The liver can store approximately 500 times the recommended daily allowance; therefore, vitamin B12 deficiency due to dietary insufficiency alone is quite rare.¹

Acquired conditions, such as pernicious anemia, also cause inadequate absorption of B12. Pernicious anemia is a condition in which the body does not produce enough red blood cells due to decreased intrinsic factor, a glycoprotein secreted by the stomach. Intrinsic factor is commonly reduced in atrophic gastritis, autoimmune diseases, and secondary to gastric surgery. **Table 3** lists additional etiologies that can contribute to an acquired vitamin B12 deficiency.

• Crohn's disease
• Helicobacter pylori infection
Intrinsic Factor
• Gastric surgery
• Pernicious anemia
• Gastritis
Hereditary
• Imerslund-Gerslbeck syndrome
• Transcobalamin II deficiency
Malnutrition/Inadequate intake
• Alcohol abuse
• Vegetarianism
Medication
• Proton pump inhibitor
• Histamine2 receptor antagonists
• Metformin

Table 3.
[Click to enlarge](#)

Pathophysiology of B12 deficiency

Vitamin B12 has several vital roles in the body. It contributes to the formation of methionine, an important part of DNA synthesis in cells that undergo rapid turnover, including those of the hematopoietic system and of the enteric lining that produces intrinsic factor. A deficiency in vitamin B12 can lead to megaloblastic erythropoiesis, a form of anemia that is characterized by large red blood cells that fail to divide via mitosis. Additionally, vitamin B12 plays a crucial role in limiting the amount of plasma homocysteine, which in high amounts can lead to endothelial cell toxicity.¹ Vitamin B12 deficiency also leads to elevated levels of methylmalonyl CoA, which interferes with fatty acid synthesis and contributes to abnormal myelin formation.

Of particular relevance to this case report, vitamin B12 acts as a cofactor in the formation of succinyl CoA, an integral part of the Krebs cycle that ultimately produces adenosine triphosphate (ATP).³ This impaired oxidative metabolism causes a depletion of ATP. Due to the high metabolic demand of the papillomacular bundle in the retina, it is believed that this depletion of ATP damages these sensitive papillomacular bundle fibers resulting in the commonly noted bitemporal optic nerve atrophy and cecentral scotoma seen in B12 deficiency optic neuropathy.⁴

Epidemiology

The prevalence of vitamin B12 deficiency increases with age, and it is estimated that 10% of people over age 75 have the disease with 10% also having coexistent folate deficiency.⁵ Deficiencies in both vitamin B12 and folate result in megaloblastic anemia, but only the vitamin B12 deficiency causes neurological impairment.⁶ Vitamin B12 and folic acid are intertwined biochemically.¹ Folic acid can minimize the hematological abnormalities of vitamin B12 deficiency, but not the neurological symptoms. Folic acid supplementation has also been shown to cause more rapid progression of neurological symptoms if vitamin B12 is not bioavailable or the B12 deficiency is not treated first.⁷

Manifestations of B12 deficiency

The classic neurological symptoms caused by vitamin B12 deficiency consist of a subacute combined degeneration and diffuse demyelination of the posterior and lateral spinal columns resulting in extremity numbness, weakness and loss of vibratory sense.^{6,8} The neuropathy is usually symmetrical and patients may present with ataxia, spasticity, hyperactive knee and ankle jerks, and even urinary and fecal incontinence.^{6,8} Similar pathological changes can occur in the cerebral hemispheres due to a defect in myelin formation that is not completely understood.^{5,6,8,9} Other systemic manifestations of B12 deficiency include generalized pallor, tachycardia, fatigue, palpitations, megaloblastic anemia, unexplained neurological symptoms (i.e., dementia, sensory ataxia, personality changes, loss of positional sense) and osteoporosis.⁶

Optic neuropathy secondary to vitamin B12 deficiency occurs in less than 1% of B12 deficient patients.⁵ It results in progressive, bilateral, painless vision loss that is often associated with reduced color vision and central or cecocentral scotomas. The optic nerve may appear normal in the early stages of disease until optic atrophy develops. In approximately 30% of cases, the visual deficiencies precede other neurological and hematological signs often due to the presence of folic acid.⁷ Optic nerve head involvement (in the form of optic atrophy) is rare, but can lead to significant visual decline.¹⁰

Diagnosis of B12 deficiency

Serum vitamin B12 is the most frequently ordered laboratory test when a patient’s history is suggestive of vitamin B12 deficiency. It is important to note, however, that a low concentration of vitamin B12 only indicates a short-term imbalance. Short-term imbalances will normalize quickly by the ingestion of a well-balanced meal with an emphasis on meat and dairy products. Interestingly, studies have shown that up to 5% of individuals can have normal vitamin B12 levels when they are, in fact, deficient.¹¹

Diagnosing B12 deficiency can be difficult based on serum B12 levels alone. Deceitfully normal levels can be seen in hepatic disorders, and falsely low levels can be seen in folate deficiency and pregnancy.^{4,12} It is helpful to measure methylmalonate and homocysteine, which are precursors in the B12 pathway, as 85% of patients with B12 deficiency will have elevated levels of these compounds.⁴ This is particularly useful when the B12 level is in the low- to borderline-low range.⁴ Additionally, a complete blood count with an elevated mean corpuscular volume (MCV) over 110 fl is also suggestive of vitamin B12 deficiency and warrants further testing.¹³

Evaluation of a patient with progressive vision loss in the presence of bilateral optic atrophy with central or cecocentral scotomas should include a detailed history including family and dietary backgrounds. The evaluation should include a thorough ophthalmic examination including careful pupillary examination, automated visual field assessment, color vision testing and OCT analysis. MRI of the brain and orbits is required to rule out compressive, ischemic, inflammatory, demyelinating and/or infiltrative etiologies. Laboratory testing should also be performed to rule out B12 deficiency.

Differential diagnosis for B12 deficiency optic neuropathy

TABLE 4
Diagnoses for Bilateral, Progressive, Painless
with Central or Cecocentral Scotomas

	Testing
Optic neuropathy	Neuroimaging
Hereditary	Neuroimaging, CSF or
Neuropathy	Genetic testing
	Genetic testing
Hereditary	Neuroimaging
	Lab work
Hereditary	Lab work

Table 4.
[Click to enlarge](#)

Optic neuropathy refers to any condition in which the optic nerve is damaged. A targeted history and thorough ophthalmic examination is necessary to narrow down a list of probable diagnoses. Progressive, painless, bilateral loss of vision and temporal optic atrophy with central or cecocentral scotomas are signs and symptoms seen in a handful of miscellaneous optic neuropathies. These optic neuropathies can be further isolated with appropriate laboratory testing, imaging studies and a detailed patient history. While this list is not exhaustive, the most common differential diagnoses (**Table 4**) are:

TABLE 5
Substances Associated with Toxic Optic Neuropathy

Chloramphenicol, Chloroquine, Isoniazid, Strept
Cyclosporine, Interferon-alpha
Chlorambucil, 5-fluorouracil, Methotrexate, Tam
Amiodarone, Cimetidine, Disulfiram, Ethambutol
Alcohol, Carbon Disulfide, Ethylene Glycol, Hexachloro
Tobacco, Toluene

Table 5.
[Click to enlarge](#)

- Compressive optic neuropathy can occur from any intraorbital mass and is most easily diagnosed with MRI. Similarly, infiltrative optic neuropathies are best diagnosed with neuroimaging and cerebrospinal fluid and/or vitreous analysis.^{4,14}
- Leber’s hereditary optic neuropathy is maternally inherited and usually found in young men age 15-30. Diagnosis is confirmed by genetic testing for the primary mutations: 11778, 3460, 15257 and 14484.⁴ Dominant optic atrophy most commonly manifests by six years of age and can be diagnosed with genetic testing for the OPA1 gene on whole blood.^{4,14}
- Radiation optic neuropathy typically develops one to five years after radiation therapy for the eye, orbit, sinus, nasopharynx or brain and can be detected on MRI.¹⁴
- Toxic optic neuropathy can result from numerous substances. (**Table 5**) Identification of the suspected toxin should be performed through blood serum and urinalysis. Tobacco-induced optic neuropathy has been controversial for several years. The mechanism of action has not been determined, but it is thought to be multifactorial.⁹ There is also a theory that vitamin B12 may play a role as tobacco itself may interfere with the absorption of B12.⁹

Treatment of B12 deficiency

Vitamin B12 deficiency has traditionally been treated with intramuscular injections at a dosage of 1 mg weekly for eight weeks followed by 1 mg monthly for life or until the underlying etiology is eliminated.¹⁵ Oral and nasal B12 formulations came to the market several years ago and offer a suitable alternative to parenteral dosing; however, they require greater patient

compliance. As mentioned above, incompletely treated vitamin B12 deficiency with oral replacement of folic acid can actually aggravate the neurological impairment related to B12 deficiency if the B12 deficiency is not corrected first.

This paper presents a rare case of partial visual recovery following vitamin B12 deficiency optic neuropathy. Most reports in the literature describe expectations for visual recovery from vitamin B12 deficiency optic neuropathy as guarded, citing time to diagnosis and treatment as the primary limiting factors.^{7,9,10,16} Improvement of visual symptoms is greatest with early and aggressive therapy.³ Interestingly, this patient recovered vision despite the presence of optic nerve pallor. In most circumstances, visual recovery does not occur once axonal loss has ensued and optic nerve pallor has formed.

Conclusion

This case report is intended to educate eyecare providers on the presentation and management of vitamin B12 deficiency optic neuropathy. It highlights the clinical importance of careful history, ophthalmic examination and use of ancillary testing. Since the advent of bariatric surgery, the importance of ophthalmic surveillance in the presence of vitamin deficiencies has been more frequently discussed in the literature.¹⁶ Additionally, Turkyilmaz et. al found that temporal quadrant retinal nerve fiber layer thickness correlates with plasma vitamin B12 levels.¹⁷ Eyecare providers should look beyond the eye and order appropriate lab work in light of pertinent ocular findings and be cognizant that incompletely treated vitamin B12 deficiency with oral supplementation with folic acid can aggravate neurological symptoms. Prompt diagnosis and recognition of vitamin B12 deficiency optic neuropathy is paramount to visual recovery.

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Influence of Participation in an Elective Course in Enhancing Perceived Critical Thinking, Independent Learning and Residency Decision-Making

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Introduction

The Association of Schools and Colleges of Optometry defines optometrists as “independent primary health care professionals for the eye.”¹ The scope of optometry has expanded over the past three decades. In an increasingly digital world with an aging population, optometrists should be prepared to adequately provide eye care to a wide variety of patients across all ages. Sound didactic knowledge and robust clinical experience are essential in training qualified doctors of optometry. Most schools of optometry offer direct patient care/clerkship experience in the second half of the second year or early in the third year of the degree program.² Depending on the robustness and diversity of clinical sites, students gain exposure to general optometry and various optometric specialties (e.g., contact lenses, pediatrics, ocular disease, low vision). Even though early exposure to optometric specialties provides a better foundation for clinic readiness, didactic coursework in most specialty topics is often not offered until the third year of optometry school, and clinical exposure in these areas may not happen concurrently. Elective courses offer the opportunity for students to gain in-depth understanding of optometric specialties.

Elective courses designed to expand knowledge in optometric specialties are currently offered to third-year students in 12 optometry schools in the United States.³ At the New England College of Optometry (NECO), third-year students are required to complete 2.75 credit hours of elective courses in the third-year of optometry school. While most of the elective courses offer only a didactic component covering advanced topics in various optometric specialties, the Special Populations Experience Course (SPEC) at NECO offers weekly clinical patient care placements (4-8 hours per week) in specialty clinics (advanced contact lenses, pediatrics, vision therapy, low vision, and individuals with disabilities) in addition to didactic content.

Goals of the SPEC elective are:

- To provide earlier exposure through a combined clinical and didactic experience in the following areas of optometry: advanced contact lenses, pediatrics, low vision, vision therapy, and individuals with disabilities
- To enhance critical thinking skills through literature search for journal club discussions and case report submission
- To enhance independent learning through self-study for clinical case presentation and mentor discussions
- To enable students to make a more informed residency decision through early clinical exposure, and potentially increase the number of students pursuing a post-graduate residency year

Currently, the SPEC elective is offered during the summer, fall and spring terms of the third year. Enrollment in the elective is application-based, and because it contains additional didactic and clinical workload, students are required to be in good academic standing (cumulative grade point average minimum of 3.0). The application process includes a brief written statement outlining the student’s interest in a particular specialty and ranking of specialties (most to least desired). An accepted student is paired with a faculty mentor with clinical and didactic expertise in the student’s choice of specialty. The students work with the mentor in clinic weekly and participate in weekly discussions with the mentor to advance their training/knowledge in the field. In addition, students are assigned to eight hours per week of primary care clinic as part of their regular third-year assignment. The didactic component of the elective requires each student to do at least one case presentation and one journal article review and to write a case report. The final grade is pass/fail. Each mentor works with a student or two per term and is compensated separately on a term basis for the mentorship provided. Historically, 10-15% of the class population has enrolled in the elective in the third year.

A recent survey found that approximately 65% of all elective courses offered in other optometry schools cover topics in specialty patient care.³ However, it is unclear whether early exposure to optometric specialties prepares students for clinic readiness in fourth year or if it is beneficial in the residency decision-making process.

The purpose of this study was to evaluate the SPEC elective's effectiveness in meeting its goals, specifically:

1. Did students perceive that this elective enhanced their critical thinking and independent learning skills compared to their primary care assignment?
2. Did early clinical exposure to optometric specialties influence their residency decision-making process?
3. Did this elective influence the choice of specialty in the residency decision-making process?

Methods

A web-based survey (**Appendix A**) was designed by the authors and sent through Google Forms to the students who completed the SPEC (classes 2013-2016) after the residency matching results were released for the class of 2016. The Institutional Review Board at NECO approved the study. Participants were given 10 days to complete the survey, the results of which were analyzed using Google Sheets and Microsoft Excel.

Results

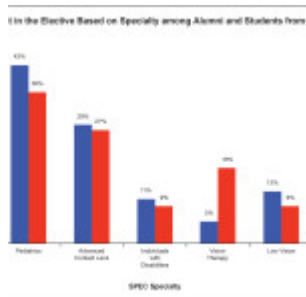


Figure 1.
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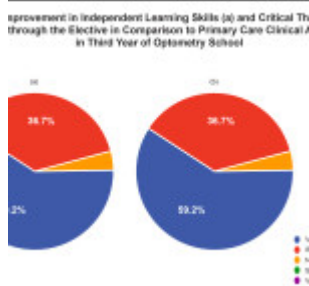


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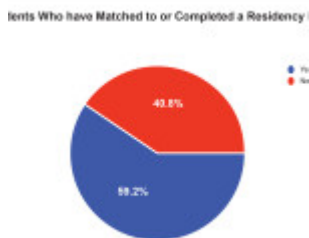


Figure 3.
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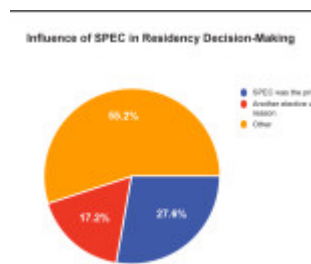


Figure 4.
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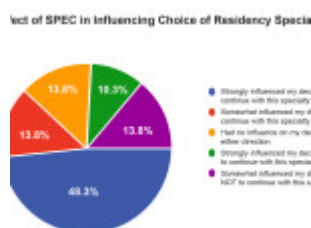


Figure 5.
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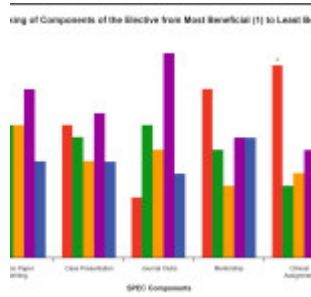


Figure 6.
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The survey was sent to 11 fourth-year students and 57 alumni (n=68). The response rates for fourth-year students and alumni were 100% (n=11) and 66.66% (n=38) respectively. **Figure 1** shows the number of students and alumni enrolled in each specialty offered in the elective.

Perception of improvement in skills

Survey respondents were asked how beneficial the elective was in improving their independent learning skills (**Figure 2a**) and critical thinking skills (**Figure 2b**) when compared with their primary care assignment in their third year. 59.2% (n=29) responded that the elective was very beneficial, and 36.7% (n=18) responded that the elective was somewhat beneficial. A small percentage (4.1%, n=2, data not shown) of respondents found that the elective was neither beneficial nor unbeneficial in improving critical thinking and independent learning skills. None of the respondents reported that the elective was not beneficial in improvement of either of those skills.

Influence in residency decision-making

59.2% of respondents (n=29; alumni = 21, fourth-year students = 8) either completed a residency or had been accepted to a residency program. (**Figure 3**) 36.7% of respondents (n=18) did not apply to any residency program. 4.08% (n=2) applied to residency program(s) but did not match (data not shown).

27.6% (n=8) responded that the elective was the primary reason for applying to residencies, while 55.2% (n=16) cited another elective as the primary reason. (**Figure 4**) Of the 29 respondents who had either completed a residency or had been accepted to a residency, 48.3% (n=14) felt that the elective strongly influenced their decision to continue with the same specialty as the elective experience. 13.8% (n=4) responded that the elective had both somewhat influenced and not influenced their decision-

making. 10.3% (n=7) of participants noted that the elective influenced their decision to not continue with the same specialty as the elective. **(Figure 5)** Other common reasons for applying for residencies were “other faculty mentorship” and “fourth-year rotations.”

Components of the elective that affected clinic readiness for fourth year

Many respondents reported that the clinical assignment, mentorship and case presentations were the most beneficial in helping them to become clinic ready for their fourth-year rotations. Activities such as journal clubs and topic paper writing were not perceived as beneficial in preparing for clinic readiness. However, a comparison of ranking across all components yielded no significant difference of rankings among SPEC components [$\chi^2 (4) = 2.7265, p=0.6046$]. **(Figure 6)**

Discussion

At NECO, SPEC is the only elective that offers clinical patient care assignment in different optometric specialties to third-year optometry students in addition to a didactic component. The goal is to introduce clinical patient care in optometric specialties early during a student’s education through mentor pairing and weekly clinical assignments to facilitate informed residency decision-making. To our knowledge, this is the first study to evaluate the influence of an elective program in the optometric residency decision-making process. In addition, this study evaluated the perceived improvement in critical thinking and independent learning skills after participating in the elective.

Past studies have shown that good critical thinking skills are linked to good professional judgment.^{4,5,6} Denial⁴ showed that entering fourth-year optometry students who scored low on a critical thinking skills test demonstrated the lowest clinical ability. Independent learning is a lifelong necessity for optometrists. In addition, in the era of evidence-based medicine it is even more important for optometry students to learn the art of independent learning, which involves identifying reliable sources of information and seeking the most up-to-date information for providing quality patient care. In this study, more than half the respondents reported that the elective improved their critical thinking and independent learning skills compared with their primary care clinical assignment. This could be due to a combination of additional clinical assignment, participation in and preparation for case presentations and journal clubs (didactic elective activities) and one-on-one mentoring, which may not be required components of primary care regular clinical assignments for third-year students.

A desire to improve skills and develop confidence has been reported to be one of the important factors in deciding whether to pursue an optometric residency.⁷ Optometry students first hear about residency programs in their first year but decide to pursue residencies in their fourth year.⁸ It can be argued that early exposure to optometric specialties may benefit students’ residency decision-making process. A web-based cross-sectional survey evaluated the factors that influenced fourth-year medical students’ career choice in internal medicine and found that educational experience in internal medicine as a student was a significant factor in the choice compared with students whose career choice was not internal medicine.⁹ Another study showed that clinical experience during clerkships combined with “role-modeling effect” from clinical teaching faculty greatly influenced student specialty choices in medical schools for residency.¹⁰ In the current study, among respondents who applied for residency, 48.3% reported that SPEC influenced them to pursue residency training in the same specialty. It is important to note that clinical exposure in optometric specialties combined with mentorship is an important hallmark of this elective. However, only 27.6% of the respondents reported SPEC as the primary reason for deciding to apply for a residency. For a small group of respondents (10.3%), the elective influenced their decision not to continue with the specialty. This can be very useful when deciding to apply, given that 17.1% of optometry residency applicants begin searching for programs at least one year before the start of residency programs, in their third year.¹¹

There are limitations to this study. We are reporting the perceived (subjective) improvement in participant skills. Conducting an assessment of skills prior to and after completion of the elective to objectively assess the impact of participation would have been helpful. Furthermore, because the elective is fairly new (class of 2013), the sample size was small. Nevertheless, the results of the study enabled an understanding of how SPEC benefitted the participants with regard to difficult choices such as residency decision-making.

Conclusion

The SPEC elective experience benefitted participants in deciding choice of residency in their third-year of optometry school. In addition, the SPEC elective was perceived by third-year optometry students to be effective in improving independent and critical thinking skills compared with the primary care assignment. Additional research is needed to assess what factors/experience influence the choice of optometric residency, which in turn could help optometric educators develop creative learning experiences.

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Appendix A.
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Normotensive Glaucoma Follow-Up with Incidental Finding of Choroidal Neovascular Membrane: a Teaching Case Report

Ryan Bulson, OD, MS, FAAO, and Ambar Faridi, MD | Optometric Education: Volume 42 Number 3 (Summer 2017)

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Background

Normotensive glaucoma is a progressive optic neuropathy that follows clinical patterns of primary open-angle glaucoma in the absence of elevated intraocular pressure (IOP).¹ Patients with normotensive glaucoma are typically followed at regular intervals several times per year for clinical examination of the optic nerve and for monitoring of IOP, automated visual fields and optical coherence tomography (OCT). The diagnosis and management of glaucoma are often complicated by ocular comorbidities, such as age-related macular degeneration (ARMD). While the exact pathogenesis is unclear, ARMD is characterized by abnormal deposition of acellular, polymorphous debris called drusen between the retinal pigment epithelium and Bruch's membrane, a condition that represents the leading cause of irreversible blindness in people 65 years of age and older in the developed world.² This case report describes a 70-year-old Caucasian female who presented for a visual field test and follow-up for normotensive open-angle glaucoma. Due to a new complaint of a central blurred spot in the right eye as well as a new central depression on visual field testing, the patient, who was also being followed for non-neovascular ARMD, was dilated and incidentally found to have a subretinal macular hemorrhage from an acute choroidal neovascular membrane (CNVM) related to neovascular macular degeneration. The case highlights the importance of a careful case history and the need for clinicians to divert from planned testing based on new information offered by the patient. This case is appropriate for optometry students in years two through four as well as optometry residents. It can be utilized in a seminar, laboratory, classroom or clinical setting.

Case Description

A 70-year-old Caucasian female presented to the eye clinic for a normotensive glaucoma follow-up appointment, including her annual threshold visual field. Her glaucoma was diagnosed in the right eye in 2012 based on moderate optic nerve cupping, inferior-temporal thinning of the retinal nerve fiber layer (RNFL) on OCT, an early superior nasal arcuate visual field defect, and strong family history (mother). Visual field and OCT findings of the left eye were unremarkable at the time of diagnosis; however, when treatment was discussed, the patient elected to initiate treatment of her left eye prophylactically. The patient's glaucoma was well-controlled on latanoprost ophthalmic solution 0.005% instilled in both eyes before bedtime. Her pertinent glaucoma findings are summarized in **Table 1**. In addition to glaucoma, her ocular history was significant for intermediate non-neovascular ARMD, a hemorrhagic posterior vitreous detachment in the right eye diagnosed four months prior, non-visually-significant bilateral nuclear sclerotic cataracts, and mild dry eyes. Her medical history was significant for hypertension, asthma, hyperlipidemia, and previous cervical cancer. Her medications included metoprolol tartrate 50 mg BID, ipratropium bromide 20 mcg/albuterol sulfate 100 mcg inhaler QID, and gemfibrozil 600 mg BID. Additionally, she used AREDS2 formula multivitamins BID and was a current daily smoker. Significant allergies included piperacillin and clonidine.

TABLE 1
Summary of Pertinent Glaucoma Findings

	Most Recent Date	Results
Idmann et al	11/18/11	OD: 18 mmHg OS: 17 mmHg
Idmann et al	2011-2016	OD: 10-18 mmHg OS: 10-17 mmHg
	11/18/11	OD: 581 microns OS: 569 microns
	06/28/16	OD: 0.784x0.75x OS: 0.80x0.70x
	01/19/12	OU: flat apical body 380, 1+ trail pigment
	06/28/16	See Figure 1 or
	06/28/16	See Figure 3
Reasons		Mother and Male

Table 1.
[Click to enlarge](#)

The patient's chief complaint was a blurred spot in her right eye for the past week. The spot was most noticeable towards the end of the day and seemed to improve with blink and the use of artificial tears. She reported no complaints with the left eye and observed no other changes to her overall vision. There was no metamorphopsia observed from either eye when using her home Amsler grid.

Incoming corrected distance visual acuity was OD: 20/30-2 and OS: 20/30+. Previous incoming corrected visual acuities were OD: 20/20- and OS: 20/25-. Pupils were equal, round and reactive to light without afferent pupillary defect. Extraocular motilities were full and concomitant OU. Cover test revealed orthophoria at distance and 6 prism diopters exophoria at near. A

manifest refraction of +0.50-1.25×105 corrected the right eye to 20/25 and a manifest refraction of +0.50-1.25×105 corrected the left eye to 20/25. Anterior segment exam was significant for mild punctate epithelial erosions within the inferior one-third of each cornea, with a tear break-up time of 2-3 seconds OU. The 24-2 threshold visual field testing was reliable in both eyes and showed a large central relative defect in the right eye and two non-clustered paracentral relative defects inferiorly in the left eye. **(Figures 1-2)** OCT of the right optic nerve revealed inferior-temporal sector RNFL thinning with borderline quadrant RNFL thinning inferiorly while the left eye demonstrated no significant thinning of the RNFL. **(Figure 3)** Due to the patient's chief complaint, slight reduction in best-corrected visual acuity and visual field findings, a dilated fundus exam was performed. This examination revealed bilateral grade 2 nuclear sclerotic cataracts, clear vitreous OU, optic nerves with cup to disc ratios of 0.70H/0.75V OD and 0.60H/0.70V OS, normal vasculature OU, and a flat and intact peripheral retina bilaterally. Examination of the right macula revealed coarse mottling with several small and intermediate drusen as well as a subretinal hemorrhage superior to the macula. **(Figure 4)** The left macula showed a mottled appearance with several small and intermediate drusen. **(Figure 5)** OCT of the macula was performed and showed confluent central drusen with a pigment epithelial detachment with overlying subretinal fluid OD, and confluent central drusen without subretinal fluid OS. **(Figures 6-8)**

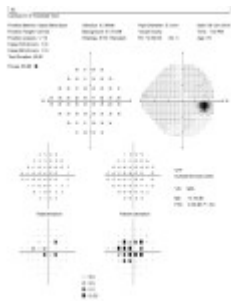


Figure 1. 24-2 Humphrey SITA Standard visual field test OD on 06/28/16 showing good test reliability with a large central relative defect.
[Click to enlarge](#)

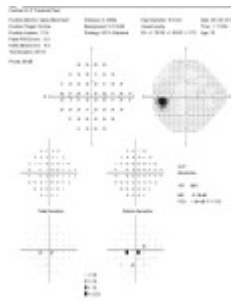


Figure 2. 24-2 Humphrey SITA Standard visual field test OS on 06/28/16 showing good test reliability with two non-clustered paracentral relative defects inferiorly.
[Click to enlarge](#)

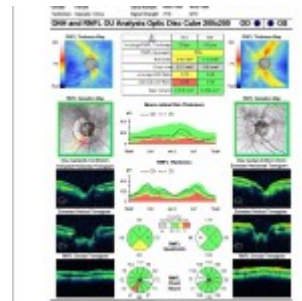


Figure 3. Optic disc OCT OU on 06/28/16 showing borderline RNFL layer thinning inferiorly OD and no significant thinning of the RNFL OS.
[Click to enlarge](#)



Figure 4. Fundus photograph OD on 06/28/16 showing a mottled appearance of the right macula with several small and intermediate drusen as well as a subretinal hemorrhage slightly superior to the macula.
[Click to enlarge](#)

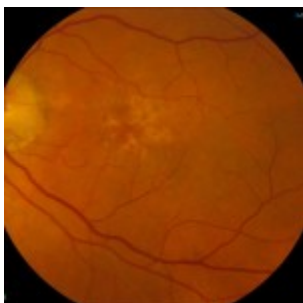


Figure 5. Fundus photograph OS on 06/28/16 showing a mottled appearance of the left macula with several small and intermediate drusen.
[Click to enlarge](#)

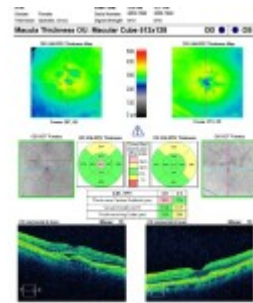


Figure 6. Macular Cube OCT OU on 06/28/16 showing increased central macular thickness of 321 μm OD and normal central macular thickness of 274 μm OS.
[Click to enlarge](#)

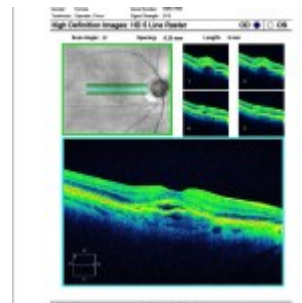


Figure 7. Five Line Raster Macular OCT OD on 06/28/16 showing confluent central drusen and pigment epithelial detachment with overlying subretinal fluid causing macular elevation.
[Click to enlarge](#)

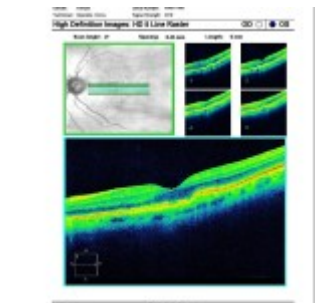


Figure 8. Five Line Raster Macular OCT OS on 06/28/16 showing confluent central drusen with normal macular contour and thickness.
[Click to enlarge](#)

A same-day consult with a retina specialist was requested, and fluorescein angiography (FA) was performed. **(Figures 9-10)** FA revealed a region of blockage superior to the fovea corresponding to the area of subretinal hemorrhage; however, within this region, specifically the portion superior-nasal to the fovea and corresponding to a pigment epithelial detachment, there was an area of early stippled hyperfluorescence that on the later frame had ill-defined leakage, i.e., occult leakage. Additionally, there was staining of numerous drusen present inferior to the fovea. Based on the FA study, the patient was diagnosed with an occult CNVM in her right eye related to exudative macular degeneration and subsequently treated with a 0.5-cc intravitreal injection of 1.25 mg intravitreal bevacizumab in the right eye. The patient was advised to continue AREDS formula vitamins and to monitor for vision changes at home with an Amsler Grid. Follow-up was scheduled with the retina specialist for four weeks later.

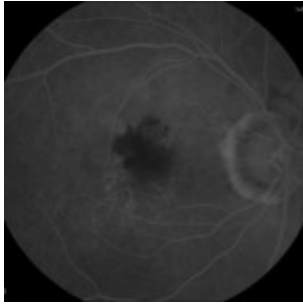


Figure 9. Fluorescein angiography OD at 1:39 showing early-phase blockage superior to the fovea corresponding to the area of subretinal hemorrhage. Superior-nasal to the fovea there is an area of early stippled hyperfluorescence corresponding to the area of pigment epithelial detachment. Additionally, there is staining of numerous drusen present inferior to the fovea.
[Click to enlarge](#)

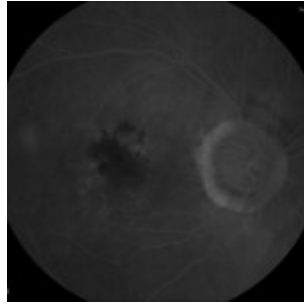


Figure 10. Fluorescein angiography OD at 7:25 showing a late-phase ill-defined area of leakage superior-nasal to the fovea.
[Click to enlarge](#)

Education Guidelines

Key concepts

1. Diagnosis and management of normotensive glaucoma
2. Diagnosis and management of non-neovascular macular degeneration
3. Diagnosis and management of neovascular macular degeneration
4. Interpretation of OCT for glaucoma and macular degeneration
5. Interpretation of fluorescein angiography

Learning objectives

1. To understand and interpret pertinent testing for patients with glaucoma, including visual field and OCT
2. To identify signs of neovascular macular degeneration on OCT
3. To identify signs of neovascular macular degeneration on fluorescein angiography
4. To understand how non-neovascular and neovascular macular degeneration are diagnosed
5. To understand how non-neovascular and neovascular macular degeneration are managed

Discussion questions

1. Knowledge and concepts required for critical review of the case:
 - a. What are the diagnostic criteria for a patient with normotensive glaucoma?
 - b. What are the risk factors for development and progression of normotensive glaucoma?
 - c. What are the diagnostic criteria for a patient with non-neovascular macular degeneration?
 - d. What are the diagnostic criteria for a patient with neovascular macular degeneration?
2. Differential diagnosis:
 - a. What are the differential diagnoses based on the patient's chief complaint?
 - b. What are the justifications for dilating a patient with a similar chief complaint?
 - c. What other conditions could explain the patient's visual field results?
 - d. What other conditions could explain the patient's optic nerve OCT results?
 - e. What other conditions could explain the patient's macular OCT results?
 - f. How do OCT and visual field findings correlate?
3. Disease management
 - a. Describe the treatment options for glaucoma

- b. What are the pharmaceutical, non-surgical treatment options for glaucoma?
 - c. Describe the different classes of pharmacological agents. For each agent, describe: drug class, dosage schedule, expected IOP reduction
 - d. What are the surgical treatment options for glaucoma?
 - e. When are AREDS multivitamins clinically indicated for macular degeneration?
 - f. Describe the treatment options for neovascular macular degeneration
4. Patient education
- a. What lifestyle modifications would be recommended for a patient with macular degeneration?
 - b. How would glaucoma be explained to a patient to facilitate an understanding of the condition?
 - c. How would both neovascular and non-neovascular macular degeneration be explained to a patient to facilitate an understanding of the conditions?
 - d. For a patient acutely diagnosed with neovascular macular degeneration, how would one best explain to the patient what will happen at the exam with the retina specialist?
 - e. What is the long-term visual prognosis for a patient diagnosed with glaucoma?
 - f. What is the long-term visual prognosis for a patient diagnosed with non-neovascular macular degeneration? Neovascular macular degeneration?
5. Critical thinking
- a. When should surgical treatment be recommended over pharmacological therapy for a patient with glaucoma?
 - b. When should patients with glaucoma be referred to a glaucoma specialist?
 - c. When should patients with macular degeneration be referred to a retina specialist?

Learning assessment

1. Clinical skills such as high plus funduscopy, binocular indirect ophthalmoscopy, acquisition of OCT images, automated visual field testing, and fundus photography can be tested in a laboratory or clinical proficiency exam
2. Clinical thinking skills and knowledge base of the clinical signs of glaucoma and macular degeneration can be tested via review of stereoscopic optic nerve photographs, fundus photography, optic nerve/macular OCT scans, automated visual field interpretation and FA images. This would ideally be done in a small-group setting, such as a laboratory or seminar, with the faculty member or clinical attending serving as the mediator of the discussion and directing the discussion to cover salient points as appropriate. The material could also be reviewed in a larger group or classroom setting as a Grand Rounds case and assessed as part of a written exam
3. Literature review on management of glaucoma and macular degeneration can be conducted and written up as a capstone or thesis project

Discussion

Glaucoma is a progressive optic neuropathy characterized by death of the RNFL ganglion cells.¹ It represents the second leading cause of blindness worldwide behind cataracts.¹ Pertinent testing for the diagnosis of glaucoma includes Goldmann applanation tonometry, corneal pachymetry, gonioscopy, stereoscopic ophthalmoscopy of the optic nerve head, RNFL analysis (most commonly via OCT) and threshold visual field testing.³ Evaluation of the macular ganglion cell complex (GCC) via spectral domain OCT has also recently emerged as a promising new tool for diagnosing and monitoring progression of glaucoma as the thickness of this region is reduced as glaucoma develops and progresses.⁴ However, as in the current case, concurrent macular disease may confound the results of this test, making interpretation of GCC loss more challenging.⁵

Normotensive glaucoma is defined as progressive optic neuropathy with subsequent visual field constriction and RNFL thinning in the presence of open angles on gonioscopy and normal IOP (<21mmHg).⁶ While normotensive glaucoma has historically been considered a distinct entity from primary open-angle glaucoma, where IOP is elevated, normotensive glaucoma may represent a continuum of the open-angle glaucomas whereby the mechanism changes from IOP-mediated to IOP-independent factors, such as abnormal vasoregulation, which produces transient ischemia. Increased frequency of disc hemorrhages as well as higher prevalence of Raynaud's phenomenon, migraines and sleep apnea in patients with normotensive glaucoma support the role of vascular perfusion in the pathogenesis of normotensive glaucoma.⁶ Other risk factors for normotensive glaucoma include age, female gender and Asian heritage.³

Despite normal intraocular pressure, the standard treatment for normotensive glaucoma is similar to that of primary open-angle glaucoma; that is, reduction of intraocular pressure.¹ Topical pharmaceutical agents, summarized in **Table 2**, represent the first-line treatment for normotensive glaucoma. Surgical interventions including laser trabeculoplasty, trabeculectomy and sclerotomy are considered in patients who are unresponsive to pharmaceutical treatment or that demonstrate progression despite sufficient IOP reduction.¹ The Collaborative Normal Tension Glaucoma (CNTGS) study found a 30% or more reduction in IOP reduced progression of visual field loss over five years, thus, this remains the standard treatment goal for most patients with normotensive glaucoma.⁷ In the CNTGS, 57% of patients achieved a 30% IOP reduction with topical medication and/or laser trabeculoplasty, while the remaining 43% required filtering surgery.⁷ Thus, some patients with normotensive glaucoma will not achieve sufficient IOP reduction from pharmacological therapy alone and therefore require co-management with an ophthalmologist specializing in glaucoma.

TABLE 2
Most Common Pharmaceutical Agents for Management of Glaucoma^a

Drug	Drug	Dosage	Approximate IOP-lowering Effect
beta-blockers	Betaxolol Brimonidine Bimatoprost Timolol	QID	27-35%
alpha-agonists	Brimonidine Bimatoprost	QID or BID	25%
prostaglandin synthase inhibitors	Bimatoprost Latanoprost Maltoprost Tafluprost	QID or BID	25%
carbonic dehydratase inhibitors	Dorzolamide Brimonidine	BID or QID	20-40%
osimertinib	Tamoxifen Tamoxifen Brimonidine	BID	20%

^aFrom American Optometric Association Clinical Practice Guidelines¹¹

Table 2.
[Click to enlarge](#)

The patient discussed in this article presented primarily for a visual field test, and was found to have a large central defect in the right eye that had not been previously noted. The left eye was found to have a smaller paracentral defect that was not noted on the previous visual field test. OCT findings of the optic nerve did not correspond to the visual field defects OD/OS. Due to these visual field results, as well as the patient's chief complaint and slight reduction in best-corrected acuity, a dilated exam was performed to rule out progression of her macular degeneration. Although the patient did show signs of dry eyes, which might have explained these factors, the asymmetry of the patient's complaint and visual field defect was not consistent with the relatively symmetrical mild dry eye findings.

Age-related macular degeneration is the leading cause of blindness and visual impairment in people 65 years and older in the United States.⁸⁻⁹ The condition is generally divided into two groups: non-neovascular or neovascular, with the former usually preceding the latter.¹⁰ Non-neovascular (also called non-exudative or "dry") macular degeneration is characterized by the presence and accumulation of yellow lipid deposits called drusen below the retinal pigment epithelium of the retina.¹⁰ Accumulation of drusen damages the retinal pigment epithelium, resulting in large areas of geographic atrophy as well as expression of angiogenic cytokines such as vascular endothelial growth factor (VEGF).¹⁰ In neovascular (also called exudative or "wet") macular degeneration, VEGF stimulates development of choroidal neovascularization (CNV) causing the characteristic clinical findings of subretinal hemorrhage, fluid exudation, lipid deposition, detachment of the retinal pigment epithelium from the choroid and, ultimately if left untreated, fibrotic scars.¹⁰ Neovascular macular degeneration is responsible for 80-90% of severe visual impairment and blindness, despite only accounting for 10-20% of macular degeneration cases.¹⁰

The gold standard for diagnosis of neovascular macular degeneration remains fluorescein angiography.¹¹ FA is a minimally invasive test that involves intravenous administration of dye in conjunction with fundus photography to allow dynamic evaluation of ocular blood flow, including blood leakage and pooling.¹¹ On FA, CNV is seen as hyperfluorescence that increases in intensity and size over time as the fluorescein leaks from the neovascular membranes.¹¹ FA patterns of CNV are classified as either "classic," which shows well-demarcated lesions with early hyperfluorescence and clear leakage in later frames, or "occult," which is characterized by a fibrovascular pigment epithelial detachment or ill-defined leakage from an undetermined source.¹² In cases where fluorescein is blocked by subretinal hemorrhage, indocyanine green angiography can be useful in identifying and characterizing choroidal neovascular lesions.¹¹ This patient demonstrated an occult pattern on FA consistent with a fibrovascular pigment epithelial detachment.

In addition to FA, spectral-domain OCT has emerged in recent years as an essential adjunctive test for diagnosing and monitoring non-neovascular and neovascular macular degeneration.¹³ Detailed cross-sectional imaging of retinal anatomy allows non-invasive visualization of detachments of the pigment epithelium and subretinal fluid due to choroidal neovascularization.¹² OCT in this patient identified a pigment epithelial detachment with adjacent subretinal fluid.

There is currently no definitive treatment for non-neovascular macular degeneration; however, the Age-Related Eye Disease Study (AREDS) demonstrated that high levels of antioxidants (500 mg vitamin C, 400 IU vitamin E, 15 mg beta carotene, 80 mg zinc, 2 mg copper) reduced progression to advanced AMD by 25% at five years for patients with moderate non-neovascular macular degeneration.⁸⁻⁹ The AREDS2 expanded on these findings and substituted lutein and zeaxanthin (main components of macular pigment) for beta-carotene. Part of the reasoning for this substitution was that beta-carotene might increase the risk for lung cancer in patients who had a history of smoking.¹⁴ Supplementation with omega-3 fatty acids [docosahexaenoic acid (DHA) and its precursor eicosapentaenoic acid (EPA)] did not appear to slow progression of the condition.¹⁴ As such, patients with intermediate non-neovascular or neovascular macular degeneration should be counseled on supplementation with the AREDS2 formula multivitamin.

In recent years, the treatment for neovascular macular degeneration represents one of the most significant advances in eye

care. Current treatment involves intravitreal injection of Food and Drug Administration-approved anti-VEGF agents, such as ranibizumab, aflibercept, and pegaptanib.¹¹ Bevacizumab, an anti-VEGF medication approved for the treatment of colon cancer, is also currently used off-label to treat neovascular macular degeneration.¹⁰ Several clinical trials (MARINA, ANCHOR, HARBOR, CATT, VIEW1, VIEW2) have demonstrated maintenance or improvement in visual acuity in patients with neovascular macular degeneration receiving regular (usually monthly) treatments of intravitreal anti-VEGF therapy.¹⁵⁻¹⁹ Human clinical trials are currently investigating platelet-derived growth factor (PDGF) antagonists as a promising alternative or combination therapy for treatment of choroidal neovascularization.²⁰ PDGF is triggered by retinal ischemia and promotes the cascade responsible for neovascular angiogenesis and, as such, inhibiting this factor represents an encouraging new therapeutic possibility for the treatment of choroidal neovascularization.²⁰ With continued advances in therapies such as anti-VEGF and anti-PDGF, vision can be preserved and even improved with prompt diagnosis and treatment of neovascular macular degeneration.

Smoking represents the only known modifiable risk factor for development and progression of macular degeneration.¹² The AREDS showed the risk for development of neovascular macular degeneration was doubled in patients who had a history of smoking compared to patients who had never smoked. Additionally, the risk of developing any macular degeneration for both males and females was doubled in active smokers, according to The Physicians' Health Study and Nurses' Health Study.²¹⁻²² As such, smoking cessation should be strongly encouraged for all patients with macular degeneration.

Conclusion

This case highlights a patient who presented for a routine glaucoma follow-up visit, but was found to incidentally have a CNVM from neovascular macular degeneration. It reflects the importance of a careful case history to determine if recent visual changes could be related to progression of ocular pathology. Finally, it underscores the need to be flexible as a clinician to deviate from one's planned exam sequence to address the patient's symptoms.

Acknowledgment

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Choroidal Melanoma and Disclosing Bad News: a Teaching Case Report

Danielle L. Weiler, OD, FAAO, and Tina R. Porzukowiak, OD, FAAO | Optometric Education: Volume 42 Number 3 (Summer 2017)

[PDF of Article](#)

Background

Although choroidal melanoma is the most common primary intraocular tumor, the incidence is rare with approximately six out of one million individuals diagnosed annually or approximately 1,400 new cases in the United States each year.^{1,2} Choroidal melanoma typically arises in Caucasians with light-colored eyes and fair skin with a propensity to burn when exposed to ultraviolet light.^{1,3} The mean age at diagnosis is mid-50s.¹ These malignant tumors occur sporadically and are largely asymptomatic leading to diagnosis at routine eye examination where it is important to differentiate from other lesions such as choroidal nevi.^{2,3} Choroidal melanomas have a high propensity to metastasize^{4,5} and are associated with high mortality rates.⁵ The liver is the most common site of metastasis followed by lung, bone, skin and subcutaneous tissue, and lymph node with five- and 10-year cumulative rates of 25% and 34%, respectively.^{4,6} Of those patients who die from choroidal melanoma, 90% die within 15 years.^{5,6} Prior to the Collaborative Ocular Melanoma Study (COMS), enucleation had been the standard of care due to the malignancy of these tumors, but improved survival rate following surgical removal of the eye had not been demonstrated.¹ Since the publication of COMS, treatment of choroidal melanoma is dependent upon the size of the tumor with the goal of preserving the eye when possible.

As optometrists are likely to diagnose choroidal melanoma during their career, they must also be prepared to discuss the potential for malignancy. Disclosing bad news is a learned skill for healthcare providers. Imparting bad news to any patient may be difficult or stressful for a provider. When communicating bad news to patients, it is imperative to consider the patient's mental health as presented in this case report. In addition to reviewing the diagnostic criteria and treatment options for choroidal melanoma, strategies for revealing bad news will be discussed. The target audience for this report is optometric educators with the target learner being third- or fourth-year optometry students.

Case Description

Initial presentation

A 65-year-old Caucasian male presented for a comprehensive eye examination in April 2013 with a chief complaint of blurred near vision in both eyes with gradual onset since his last dilated fundus exam one year prior. Ocular history was remarkable for mild cataract and dry eye syndrome in both eyes. Medical history was significant for severe bipolar disorder with psychosis, dissociative disorder, mood disorder, major depressive disorder, and history of suicidal ideations for which he was under the care of the psychiatric primary care team. Additionally, his medical history was significant for hyperglycemia, colon polyps, hypothyroidism, hypogonadism, hypercholesterolemia, hypertension, muscle cramps, osteoarthritis and sleep apnea. For these conditions, he was taking aripiprazole (Abilify), atorvastatin (Lipitor), cyclobenzaprine (Flexeril), diclofenac (Zorvolex), hydroxyzine (Vistaril), lamotrigine (Lamictal), levothyroxine (Synthroid), sertraline (Zoloft), simethicone (Gas-X) and testosterone intramuscular injections (Delatestryl). He reported an allergy to naproxen. His family history was significant for glaucoma in his maternal grandmother. He quit smoking in 1985 and reported no history of recreational drug and alcohol use. He was oriented to time, place and person with a flat affect.



Figure 1. Fundus photographs at initial presentation, A: right eye, B: left eye.

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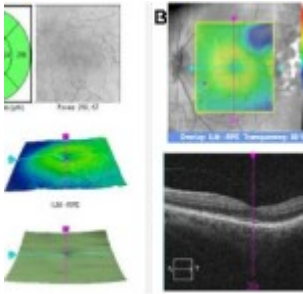


Figure 2. Spectral domain OCT macular cube (A: right eye, B: left eye): distinct foveal pit OU.
[Click to enlarge](#)

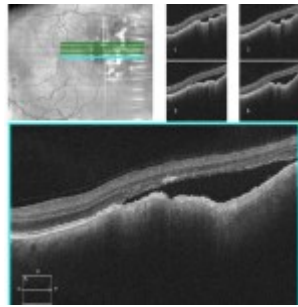


Figure 3. High-definition spectral domain OCT through the lesion OS revealing neurosensory detachment with underlying choroidal lesion with no internal reflectivity; findings consistent with choroidal melanoma.
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Best-corrected visual acuities were 20/20- right eye (OD) and 20/20 left eye (OS). Pupils were equally round and reactive to light without an afferent pupillary defect. Extraocular muscles were smooth and full in both eyes (OU). Confrontation visual fields were full to finger counting OD, OS. Slit lamp examination revealed 1+ nuclear sclerotic cataract OU and 1+ anterior cortical cataract OD. Intraocular pressures (IOPs) by Goldmann applanation tonometry were 16 mmHg OD, OS at 2:15 p.m. Dilated fundusoscopic examination revealed a 4DD vertical x 5DD horizontal pigmented, elevated choroidal lesion with overlying orange pigment temporal to the fovea OS (**Figure 1**) but was otherwise unremarkable. Optical coherence tomography (OCT) was consistent with choroidal melanoma OS (**Figures 2-3**).

At the end of the examination, the patient was brought into the attending office to arrange for a private setting, to minimize interruptions, and to allow for more time with the patient. He was asked if any family members were present that he would like to include in the conversation. Both parties were seated at eye level. He was asked if he knew the reason for the additional testing that had been performed. The patient was shown photographs of the new choroidal lesion and advised of clinical suspicion for malignancy and the need for additional work-up. As the patient did not show any emotion throughout the discussion about possible malignancy, he was asked if he comprehended to which he voiced understanding. Given his history of suicidal ideation, he was asked if he would like to speak to the clinical mental health care coordinator prior to leaving his appointment, but he declined this service. Finally, the need for an urgent referral to Retina was discussed with the patient, but coordination of care was not possible while the patient was in-office because the specialist was in the operating room. Therefore, the patient was informed that he would receive a phone call with an appointment. Liver function tests and chest x-ray were ordered, and the patient was advised to have these completed on the same day as the Retina appointment. Additionally, his primary care team was notified of his ocular findings to provide interdisciplinary support as needed.

The following day, Retina was not able to reach the patient via phone to schedule an appointment, so the technician asked the authors for assistance with coordinating his care. Because of the patient's flat affect and extensive psychiatric history, the authors became concerned for the patient's welfare. Thankfully, his wife confirmed the patient's well-being and stated she would bring him to the Retina appointment that afternoon. Ultrasonography of the choroidal lesion (**Figure 4**) revealed a diameter of 10.2 mm, thickness of 2.6 mm, low internal reflectivity (ultrasonic hollowness), and no associated subretinal fluid. The retinal specialist agreed with the provisional diagnosis of choroidal melanoma and referred the patient to a retinal oncologist.

Retinal oncology consultation

Two weeks later, the patient's vision remained stable (OD 20/25, OS 20/40 pinhole 20/20). The choroidal lesion measured 7.25 mm in its greatest diameter with a height of 1.26 mm with

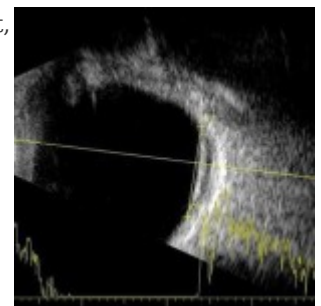


Figure 4. Ultrasonography OS: A-scan and B-scan confirming low internal reflectivity of the

ultrasonography. OCT demonstrated subretinal fluid, and fluorescein angiography showed hyperfluorescence with stippled mottling of the left temporal posterior pole. Liver function tests (**Table 1**) and chest x-ray were normal. The impression of the retinal oncologist was a small choroidal melanoma OS. Due to the melanoma's location adjacent to the fovea, the retinal oncologist and patient opted for observation for documented growth as treatment would likely have deleterious effects on the patient's vision.

choroidal lesion and no associated subretinal fluid.
[Click to enlarge](#)

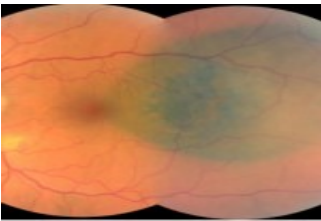


Figure 5. Fundus photograph OS nine months following initial presentation.
[Click to enlarge](#)

TABLE 1 Liver Function Test Results	
Name	Result
	35
	95
AST	27
ase (GGT, gamma-GT, y-GT)	16
or LD	473
	0.6

Table 1
[Click to enlarge](#)

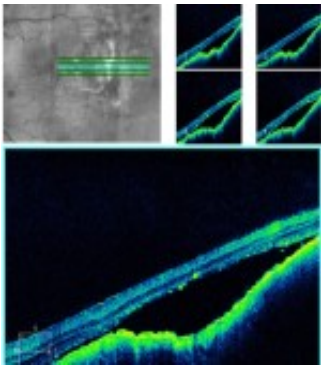


Figure 6. High-definition spectral domain OCT through choroidal melanoma OS revealing neurosensory detachment with subretinal fluid.
[Click to enlarge](#)

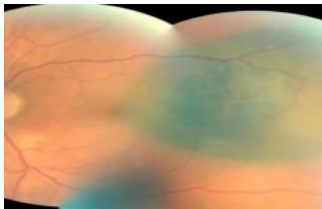


Figure 7. Fundus photograph OS two months after brachytherapy (artifact at inferior-temporal vascular arcade).
[Click to enlarge](#)

Subsequent follow-up visit

The patient returned to the authors' care nine months following his initial presentation stating that his left eye had become painful approximately one week prior. He described the pain as a constant dull ache of the anterior segment. He reported that he had two additional visits with the retinal oncologist with no changes in the choroidal melanoma. He reported no changes to his medical history, medications or allergies. Visual acuities were 20/25 OD and 20/30-2 pinhole 20/25 OS. Pupils remained equally round and reactive to light without an afferent pupillary defect. External and slit lamp examination were stable OU. IOP by Goldmann applanation tonometry was 13 mmHg OD, OS at 1:48 p.m. Dilated fundus examination revealed interval growth of the choroidal melanoma (**Figure 5**) and OCT showed subretinal fluid (**Figure 6**). The patient was informed the cause of his eye pain was from dry eye syndrome for which he was instructed to use warm compresses with lid massage and prescribed carboxymethylcellulose 0.5% ophthalmic solution four times daily in both eyes. Additionally, he was counseled regarding the growth of the melanoma and the need to return to the retinal oncologist for treatment despite possible vision loss.

At his retinal oncology visit the following week, plaque brachytherapy was recommended. Additionally, computed tomography (CT) of the chest and abdomen to rule out metastasis was ordered, and radiation oncology was consulted. CT of the chest and abdomen was stable without evidence of metastatic disease. Radiation oncology reported the tumor had a basal diameter of 8.4 mm by 5.5 mm, height of 1.74 mm, and macula-to-tumor margin of 0 mm. They recommended delivering a dose of 85 Gy to the tumor apex with a 14-mm I-125 plaque and indicated they would coordinate a surgery date with the retinal oncologist. The patient underwent fine-needle biopsy and plaque brachytherapy placed at the tumor apex for one week. The fine-needle biopsy was sent for DecisionDx-UM classification and found to be Class 1A which is associated with a low risk of clinical metastasis within five years.

The patient returned to the authors' care two months after plaque brachytherapy with a complaint of double vision following the surgery that had since resolved. He reported no changes to his medical history, medications or allergies. Best-corrected visual acuities were 20/25 OD and 20/20-2 OS. Pupils remained equally round and reactive to light without an afferent pupillary defect. Extraocular movements were full OU and confrontation visual fields were full to finger counting OD, OS. External and slit lamp examination were stable OU. IOP by Goldmann applanation tonometry was 13 mmHg OD, OS at 8:14 a.m. Dilated fundus examination revealed a decrease in the overlying orange pigment and stable size of the melanoma (**Figure 7**). The patient was reassured that his visual acuity had not been affected by plaque brachytherapy, but the cataract in his right eye was causing a slight decrease in vision. He was instructed to continue care with the retinal oncologist as directed and to follow-up with the authors in one year or as needed if he experienced a change in vision.

Education Guide

The education guide contains discussion points to help facilitate the thoughtful discussion of the case.

Key concepts

1. Recognition of clinical signs of choroidal melanoma
2. Understanding timely referral to retinal oncology and systemic work-up for choroidal melanoma
3. The importance of individualized approach to breaking bad news
4. The simulation of communicating bad news improves future clinical outcomes

Learning objectives

At the conclusion of this learning activity, participants should be able to:

1. Describe the diagnostic criteria of choroidal melanoma
2. Review the management of choroidal melanoma
3. Understand the key components to effectively impart bad news to patients
4. Become familiar with the skills required to deliver bad news to patients

Discussion questions

1. Knowledge, concepts, facts and information required for critical review of the case
 - a. Does the patient fit the typical demographics for the ocular diagnosis?
 - b. Does the patient's general health play a role in the ocular diagnosis?
 - c. What are the clinical characteristics of choroidal melanoma that help differentiate it from choroidal nevus?
2. Differential diagnosis
 - a. What is the differential diagnosis (after case history and after the ocular health exam)?
 - b. What tests should be performed to narrow the differential diagnosis?
3. Patient management
 - a. What treatment would be most appropriate for the patient?
 - b. How quickly should the patient undergo treatment?
 - c. How should the patient be managed after treatment?
4. Communication with the patient regarding diagnosis, prognosis, treatment options and potential sequela
 - a. What are the important elements of breaking bad news?
 - b. How should the patient be educated regarding the diagnosis and prognosis?
 - c. Given the patient's known psychiatric disease, how does this change the approach to the delivery of bad news?
 - d. What is the risk of the fellow eye developing the same condition?
 - e. What aspects of treatment may be challenging for the patient?
 - f. What potential treatment side effects should the patient be familiar with?
5. Critical thinking
 - a. What were the complicating factors in this care?
 - b. How would you have managed this case differently?

Learning assessment

1. Knowledge base of the condition can be tested via photos, OCT, ultrasonography
2. Knowledge base of the differential diagnosis can be tested through development of a table comparing characteristics of different posterior segment pigmented lesions
3. Critical thinking skills can be assessed by case reports that are either hypothetical examples or from a review of the literature
4. The skills required to relay bad news can be assessed via small group discussion, role-playing with a trained simulated patient, or during teaching moments in clinic

Discussion

The purpose of this case report is to help clinical novices review the clinical findings congruent with choroidal melanoma and develop strategies to break bad news. A faculty member or teaching assistant could lead a discussion of the case presentation in either a large classroom setting or small group. In the course of the discussion, students should be given the initial case presentation in a step-wise fashion (i.e., history, fundus photo, ocular coherence tomography, ultrasonography). This will enable the learner to critically think through the clinical presentation and differential diagnosis.

Following the discussion to arrive at the ocular diagnosis, the key components of breaking bad news can be discussed. After this didactic component, students can be given the opportunity to role-play breaking bad news and be given constructive feedback from the exercise. This case provides an additional layer of complexity given the patient's psychiatric history, but it allows for students to practice incorporating an individualized approach to breaking bad news. Some educators may view this additional complexity as a limitation depending upon the level of the trainee, so the psychiatric history could be pared down at the discretion of the instructor.

Choroidal melanoma

Choroidal melanomas are malignant tumors arising from abnormal proliferation of pigmented cells in the choroid. In comparison, choroidal nevi are benign melanocytic lesions of the choroid. Making the correct diagnosis of choroidal nevus vs. choroidal melanoma is crucial. In this case, the patient presented for an annual comprehensive eye exam with a 4 DD vertical x 5 DD horizontal pigmented, elevated choroidal lesion with overlying orange pigment temporal to the fovea OS that had not been present on the dilated fundus exam one year prior. The primary differential diagnosis considered in this case was choroidal nevus. Additional differential diagnoses for pigmented lesions of the posterior segment include congenital hypertrophy of the retinal pigment epithelium (RPE), adenoma or adenocarcinoma of the RPE, reactive hyperplasia of the RPE, congenital simple hamartoma of the RPE, combined hamartoma of the retina and RPE, and choroidal detachment.⁷

TABLE 2
Growth of Small Choroidal Melanoma Using "To Find Small Ocular Melanoma Using Helpful Hints Daily" (TFSOM-UHHD) mnemonic*

Clinical Feature	Hazard Ratio	Tumor Growth Factor Present
mm	2	19
el present	3	27
increased vision, flashes/floaters	2	23
el present	3	30
within 2mm of optic disc	2	13
lowers	3	25
ilo	6	7
t	<1	49

et al. 1970

Table 2
[Click to enlarge](#)

TABLE 3
Characteristics of Choroidal Melanomas*

Tumor Size	Mortality Rate at 5 years
1.5-2.4 mm apical height	16%
5-16 mm basal diameter	
2.5-10 mm apical height	32%
≤16 mm basal diameter	
>10 mm apical height	53%
>16 mm basal diameter	

Melanoma Study

Table 3
[Click to enlarge](#)

Several mnemonics for characterizing lesions, including ABCDE as used in dermatology, have been described in the literature. With the ABCDE mnemonic, a provider looks at the following clinical characteristics of the lesion to determine suspicion for malignancy: asymmetry, borders, color, diameter and elevation. More specific to eye care, the mnemonic "To Find Small Ocular Melanoma Using Helpful Hints Daily" (TFSOM-UHHD) described by Shields et al.⁸ is outlined in **Table 2**. These TFSOM-UHHD risk factors may be used in predicting the malignant transformation of choroidal lesions thereby directing a management plan. The presence of three or more risk factors is associated with a greater than 50% change of tumor growth in five years, whereas the absence of all risk factors results in a 3% chance.^{8,9} The most reliable way to diagnose choroidal melanoma is clinical examination; however, ultrasonography, fluorescein angiography, indocyanine green angiography, enhanced depth OCT, autofluorescence, and fine-needle biopsy can also be helpful.¹⁰

The COMS defined choroidal melanomas by size and delineated the optimal treatment for each (**Table 3**). More recently, the American Joint Committee on Cancer proposed staging choroidal melanomas based upon intraocular examination, serum tests (complete blood count and liver function tests) and imaging.¹¹ The use of baseline imaging is controversial because the yield of finding metastasis is low; however, patients who demonstrate metastasis at presentation are often spared aggressive treatment of the primary lesion.¹¹ When opting to order baseline imaging, one of the following protocols should be used: 1) CT of the chest and abdomen with liver protocol, 2) whole body positron-emission tomography (PET)-CT, or 3) liver magnetic resonance imaging (MRI) and chest CT.¹¹

The management of melanoma depends upon the tumor size, tumor location, associated features, status of the fellow eye, patient's systemic status and patient's desire.¹⁰ Management choices for choroidal melanoma include transpupillary thermotherapy, plaque radiotherapy, charge particle irradiation, local resection, enucleation or orbital exenteration.¹⁰ The management of small choroidal melanomas remains controversial. Observation can delay treatment and increase the risk of metastasis¹¹ by a factor up to eight if TFSOM-UHHD risk factors are present.¹² With this said, the possibility of vision loss from treatment must be considered, such as in this case. However, recent reports do not recommend observation except in unique situations such as in an elderly, medically unstable patient, a patient with advanced non-ocular malignancy, or a patient with vision loss in one eye and small- to medium-sized melanoma in the better seeing eye.^{11,13} Since the publication of the COMS trial results, brachytherapy has become the treatment of choice for choroidal melanomas with a diameter less than 18 mm and apical height less than 12 mm.¹³ Brachytherapy is a type of radiotherapy where a high concentration of radiation is delivered

locally to the tumor.³ The choice of isotope is based upon the tumor size, tumor depth and location of the melanoma.^{3,11} However, brachytherapy is not without complication, including cataract formation, neovascular glaucoma, radiation retinopathy, maculopathy and optic neuropathy.¹⁴ Additionally, Sener et al. prospectively evaluated for ocular motility disturbances following plaque brachytherapy and postulated that patients could experience transient diplopia following the procedure as is seen with glaucoma implants.¹⁵ This could account for the postoperative diplopia this patient experienced.

Disclosing bad news and counseling a psychiatric patient

Sharing bad news with patients is necessary in any medical field. Many providers feel under-trained and uncomfortable communicating bad news,¹⁶ and the evidence base for best practices in imparting bad news is limited.¹⁷ However, a growing body of evidence shows physicians’ communication skills play a crucial role in how well patients cope with bad news.^{18,19} Thus, delivery of bad news requires not only knowledge of the diagnosis but also fundamental communication competency and professionalism.²⁰ Bad news is any information that could negatively impact a patient’s expectations about their present or future.^{16,21} There are individual differences in how patients perceive bad news based upon their life experience, personality, spiritual beliefs, philosophical standpoint, perceived social supports, emotional hardness and mental capacity.^{16,22,23} These important considerations must be weighed against the importance of building trust in the provider-patient relationship with disclosure of bad news.²⁴ With this said, revealing bad news does not need to be a single event but can be a gradual building of knowledge.¹⁷ Additionally, a multidisciplinary approach to offering support to the patient may be beneficial.

Several guidelines such as ABCDE,²⁵ BREAKS²⁶ and SPIKES²⁷ have been developed to prepare healthcare providers to impart bad news. The key elements of each guideline are summarized in **Table 4**. These guidelines divide the interaction into three basic steps:²⁸ preparation, the information itself, and an empathic response. SPIKES is a six-step strategy developed by oncologists²⁷ and is the most popular framework.^{19,29} Although each step is not required with every episode of disclosing bad news, the steps are meant to be followed sequentially.²⁷ Some limitations of the SPIKES protocol include that it may not be useful for all healthcare professions such as nursing, the communication strategy is too formulaic, and it is unclear if the strategy follows patient preferences for receiving bad news.^{19,30} Ultimately, this recommendation is meant to serve as a general guide and should not be viewed as overly prescriptive.¹⁸ Medical students who had an experience breaking bad news to a trained standardized patient followed by feedback performed better on a clinical proficiency than students without this experience.³¹ In optometry, most outpatient visits are well-suited for incorporating this method when breaking bad news; however, it may be difficult in the midst of a hectic clinic schedule to ensure there is adequate time in a private setting with no interruptions. Key elements from SPIKES with patient communication examples are outlined in **Table 5**.

TABLE 5
Key Elements from SPIKES Protocol with Examples of Patient Communication

SPIKES Step	Key Elements	Example Patient Communication
Setting up	<ul style="list-style-type: none"> Arrange for a private setting Involve significant others Set down at least 10 min Make connection with patient Manage time constraints and interruptions 	
Preparation	<ul style="list-style-type: none"> Use open-ended questions to establish patient understanding of situation 	<p>What have you heard about your retinal situation so far?</p> <p>What is your understanding of the situation so far?</p>
Struck	<ul style="list-style-type: none"> Use patient's own words to restate what you have heard Use open-ended questions to establish patient understanding of situation 	<p>What have you heard about your retinal situation so far?</p> <p>What is your understanding of the situation so far?</p>
Knowledge	<ul style="list-style-type: none"> When the patient has heard what you have said, ask if they understand Use open-ended questions to establish patient understanding of situation 	<p>What have you heard about your retinal situation so far?</p> <p>What is your understanding of the situation so far?</p>
Empathy	<ul style="list-style-type: none"> Respond to any emotion Respond empathetically Respond to any emotion 	<p>What have you heard about your retinal situation so far?</p> <p>What is your understanding of the situation so far?</p>
Summary and Strategy	<ul style="list-style-type: none"> Summarize what you have said Summarize what you have said Summarize what you have said 	<p>What have you heard about your retinal situation so far?</p> <p>What is your understanding of the situation so far?</p>

Table 5
Click to enlarge

In this case, the patient had multiple psychiatric diagnoses making it unclear how he would perceive bad news, and the authors became concerned for his welfare when the retina clinic was unable to contact him. In general, psychiatric patients may be uncooperative or hostile, may be at increased risk for suicide, or may become distressed more easily than the general population leading to some information being withheld.²³ Despite this, most psychiatric patients and providers alike believe patients have a right to information about their treatment and diagnosis.^{23,32}

In the psychiatric literature, there are two similar yet distinct personality types that could apply to this patient based on his flat affect with short answers throughout his exam: aloof or avoidant. The uninvolved-alloof personality type has the tendency toward isolation and may give an impression of aloofness and solitariness.²¹ While the aloof person seems indifferent, he or she uses isolation for protection from painful experiences and emotion.²¹ When communicating with aloof patients, providers should keep in mind that these patients are sensitive and fragile despite their apathetic demeanor, but uninvolved-alloof patients may accept family involvement.²¹ In contrast, the avoidant personality type exhibits social inhibition and avoidance of social interaction.³³ The avoidant person is hypersensitive to criticism and has a fear of negative evaluation.³³ Thus, the avoidant person has profound anxiety about exposure of perceived weakness and being considered inferior.³³ Avoidant patients would appreciate gradual disclosure of information and are prone to fantasy with fear of illness becoming greater in their imagination.³³ The avoidant patient may have difficulty disclosing these oversized fantasies, which could lead to suicidal ideation.³³

TABLE 4
Elements of Strategies for Breaking Bad News

	BREAKS
	B = Background
Relationship	R = Rapport
	E = Explore
Emotional reactions	A = Announce
Emotions	K = Kinding
	S = Summarize

SPIKES²⁷

Table 4
Click to enlarge

Conclusion

Choroidal melanoma, while rare, is the most common primary intraocular tumor. It is essential for primary eyecare providers to be aware not only of the clinical features congruent with these malignant tumors but also to be prepared to break bad news to these patients. Using the SPIKES six-step strategy for imparting bad news will assist in building trust in the doctor-patient relationship.

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Communicating Educational Objectives in an Optometry Course

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[PDF of Article](#)

Background

Educational context

The purpose of this study is to investigate how to communicate written course objectives within the course Visual Optics so students can be informed effectively about what they should learn. This course is offered in the first year of the four-year optometry program at the Southern California College of Optometry at Marshall B. Ketchum University (SCCO). Resources include a course handbook and self-tutorial exercises. The course handbook contains lecture and laboratory class notes set out in chapters. Each handbook chapter begins with an advance organizer, which is a type of introduction that aims to bridge the gap between what the students may already know and what they will learn.^{1,2} This is followed by the behavioral objectives^{3,4} listed in a nested form, which consists of a small number of general objectives, each with a subset of specific learning outcomes constructed using Mager's³ behavioral-objective format (Gronlund,⁵ ch. 2). Each self-tutorial consists of the behavioral objectives set out as headings, with relevant questions listed under each heading, and a list of answers to provide feedback to the student. My reflections on the current implementation led to a set of 10 inquiries, six of which are presented in the current paper.⁶

INQUIRIES

Inquiry 1. How do students actually use objectives?

Despite the large volume of papers published on the topic of behavioral objectives, surprisingly few authors have considered whether students actually use the supplied objectives.⁷⁻¹¹ Unfortunately, the conclusions of those studies differ widely. Several authors have studied the specific strategies of those students who do make some use of supplied objectives (**Table 1**).^{9,12,13} Of these, only Mast et al.'s study involved a genuine educational context; that is, they studied actual student behaviors in a real educational program rather than having subjects (or students) participate in an experimental situation designed by the investigators.¹³ In addition to these observational studies, Jiang and Elen¹¹ hypothesized a three-part cognitive mediation paradigm, in which the student (1) interprets the objective, (2) uses the objective for goal-directed learning, and (3) self-tests to the objective. In relation to the current course, it would be useful to know how students use the objectives (if at all), and whether the students' strategies match those of previous studies (**Table 1**) and the cognitive mediation paradigm.¹¹

(1) read the objectives to identify where important material may be found	0.000-0.000 (N)	1.0
(2) read the text to locate specific passages related to the objectives	0.000-0.000 (N)	2
(3) read the objectives to determine the form of the answer questions	0.000-0.000 (N)	1.0
(4) read the objectives to determine what is important to do to answer the answer questions	0.000-0.000 (N)	1.0
(5) read the objectives to determine what is important to do to answer the answer questions	0.000-0.000 (N)	1.0
(6) read the objectives to determine what is important to do to answer the answer questions	0.000-0.000 (N)	1.0
(7) read the objectives to determine what is important to do to answer the answer questions	0.000-0.000 (N)	1.0
(8) read the objectives to determine what is important to do to answer the answer questions	0.000-0.000 (N)	1.0
(9) read the objectives to determine what is important to do to answer the answer questions	0.000-0.000 (N)	1.0
(10) read the objectives to determine what is important to do to answer the answer questions	0.000-0.000 (N)	1.0

Table 1
[Click to enlarge](#)

Inquiry 2. Do students have previous experience in the use of objectives?

My literature search uncovered no direct studies of the effect of prior experience with objectives on students' current use of objectives. In relation to the current course, students who have used behavioral objectives in the past might perform better with objectives than students who lack this experience.

Inquiry 3. Are there ways to present objectives to enhance learning?

The current handbook has the behavioral objectives placed near the start of each chapter. It is natural to question whether other placements could be more helpful for students. The literature indicates that interspersing objectives within the passage before each paragraph leads to significantly higher test performance than other single placement alternatives.^{14,15} In addition, Kaplan found greater learning when objectives were placed before and after a passage than when they were placed in either location alone.¹⁶ Contrary to expectations, a larger number of objectives is not a deterrent to students' use of objectives,¹³ nor does it have a significant effect on learning.¹⁷

Inquiry 4. Does completion of questions promote learning?

Several studies show an important effect of practice with feedback on test performance in objectives-based curricula,^{11,18-22} consistent with the self-testing component of the cognitive mediation paradigm.¹¹ These beneficial effects of practice, unfortunately, are reduced greatly when students are required to transfer knowledge to unfamiliar situations.²² In relation to the current course, it would be helpful to know if completion of the self-tutorials provides appropriate opportunities for practice and feedback.

Inquiry 5. Do objectives increase the ease and efficiency of discovering what should be learned?

Rushin and Ballin calculated study efficiency as the ratio of test performance to study time, in points per hour.²³ Using these measures, undergraduate students provided with objectives were significantly more efficient than those without objectives. In Mast et al.'s study,¹³ medical students stated that shortage of time was a reason for using objectives, and that objectives improved the efficiency of their study time. In contrast, two other studies did not find a replicable effect of objectives on students' reports of knowing what they should learn.^{18,19}

Inquiry 6. Do exam questions meet students' prior expectations of learning?

Little is known as to whether objectives provide students with accurate expectations of test content. Medical students reported using objectives less when they found that the objectives were not being tested.¹³ Since providing students with appropriate expectations is cited as an important reason for using behavioral objectives,²⁴ it was important to know if the objectives in the current course were assisting students in this respect.

Methods

A survey was designed to address the six inquiries of this study. The aims of this survey were:

1. To determine how students use objectives in the course, and whether published strategies are representative of actual uses (inquiry 1). Eighteen strategies from three papers^{9,12,13} were presented as Likert items (**Table 1**). Participants were also asked to contribute their own strategies in an open-ended question.
2. To document the level of previous experience with objectives (inquiry 2). Participants were asked to estimate the percentage of previous courses containing overt behavioral and non-behavioral objectives. They did this for: the optometry program to date; their undergraduate program; their time at high school; and other degree or certificate programs, if applicable. Participants were provided with definitions and examples of behavioral and non-behavioral objectives. An objective was considered behavioral if it included an observable behavior describing what the student should be able to do, and included the particular content on which the student was to act (e.g., to do something with facts, concepts, procedures or instruments).³
3. To determine students' attitudes to the placement of objectives within each chapter (inquiry 3). Participants' preferences for objectives placed before, within or after the text were assessed with a multiple-choice question.
4. To determine how students use the self-tutorials, and to elicit their opinions on the quality of feedback in those tutorials (inquiry 4). Participants were asked to rate their level of use of self-tutorials on a Likert scale. Two open-ended questions asked participants to describe how they used the self-tutorials, and to comment on the quality of the feedback.
5. To determine whether objectives increased the ease and efficiency of discovering what should be learned, and whether students' prior expectations of what to learn were consistent with the tests (inquiries 5 and 6). The ease and efficiency of discovering what should be learned were assessed with Likert scales. Participants were asked in open-ended questions if any objectives had hindered their study, if test content agreed with their prior expectations, and to provide examples of test questions of an unanticipated type.

The students were asked to take part in this survey after completion of the course. Two research assistants made brief recruiting presentations to the class, sent e-mail invitations to participate in the study, and personally approached students. They mailed individually addressed survey copies to students who expressed interest in the survey. Participants were allowed to take as much time as needed to complete the survey, and they returned the completed surveys by internal institutional mail at no cost. The research assistants sent reminders to participants to return completed surveys.

Where Likert scales were used, they were of the form strongly agree (SA), agree (A), neither agree nor disagree (N), disagree (D), and strongly disagree (SD). The study was designed to meet ethical considerations in educational action research.^{25,26} Informed consent was obtained from each participant. For anonymity, the class year was not included in this report. The SCCO Institutional Review Board determined the study to be "exempt" from review.

Results

Twenty-two participants completed the survey, a response rate of 21%. The replies to all open-ended questions were coded to a smaller number of concepts using content analysis.⁶

How do students actually use objectives?

Participants used a Likert scale to rate their level of agreement with each of 18 published strategies for the use of objectives^{9,12,13} (**Table 1**). The binomial test was used to discover significant levels of agreement or disagreement with each strategy. Post-hoc power estimates were made.²⁷ For a two-tailed test with $\alpha = 0.05$, these tests had 80% power to detect a change of $\pm 31\%$ away from the null hypothesis of 50% of participants agreeing and 50% disagreeing. Thus, the binomial test was well-powered to detect strong levels of participant agreement and disagreement. The Bonferroni-corrected significance level (α) of 0.002 778 (that is, 0.05/18) was also used to control for family-wise error rates.

The participating cohort reported significant levels of agreement and disagreement with various strategies, and these results are summarized in **Table 1**. Participants were then asked, “How often did you use the objectives in Visual Optics?” Nineteen of 22 used the objectives often or very often, and the remaining three used them occasionally.

Twenty-one participants described how they used objectives in the course. Twelve participants provided reasonably detailed linear accounts of the steps they usually followed, eight provided possibly incomplete narratives that did not contain multiple steps, and one described a non-linear approach in which the objectives and self-tutorial were used to create a personal study guide.

In the group of 12 participants who described linear processes, only four described the three parts of the cognitive mediation paradigm in order.¹¹ For example, here is participant 4’s response (with the three steps annotated): “I would read the objectives [Step 1, interpretation of objectives], then read all of the material (text) and highlight the information pertaining to the objectives [Step 2, goal-directed learning]. After I would read group study notes & questions that quizzed me on my study/reading [Step 3, self-test to the objective].” A diversity of linear, stepped approaches was found with the remaining eight participants.

The responses of all 21 participants were then read to identify the presence or absence of parts of the cognitive mediation paradigm,¹¹ regardless of order. Ten participants described activities consistent with interpretation of the objectives, 12 described goal-directed learning, and 11 reported self-testing to the objectives.

Responses were read to identify other characteristics of students’ uses of objectives. First, with regard to when the objectives were used, five participants commenced their descriptions as they were approaching a test. Second, some participants gave explicit reasons for their use of objectives. These reasons were classified as orientating oneself to the topic (two participants), goal-directed learning (one), self-testing (three), reinforcement (one), and test preparation (two). Finally, the relationships between the participants and other students in the class were assessed. Most participants (19 of 21) did not mention anyone else present with them. Only one participant related how he or she used the objectives to quiz classmates during group study, and another noted that the instructor covered the objectives during the lecture.

TABLE 2
Participants' Prior Experience with Course Objectives

Percentage of Courses (mean)	
Behavioral Objectives	Non-Behavioral Objectives
56.8 (25.2)	51
43.9 (29.7)	58
38.1 (33.3)	57
55.0 (n.a.)	45

non-behavioral objectives, please consult the text

Do students have previous experience in the use of objectives?

Participants generally had extensive experience with behavioral and non-behavioral course objectives (**Table 2**).

Table 2
[Click to enlarge](#)

What are students’ attitudes to the placement of objectives within each chapter?

Twenty-two participants completed this question and, of these, two expressed split preferences, which were distributed to the respective categories as half-scores. Fifteen preferred objectives placed only at the start of the chapter. ‘Two and a half’ participants each preferred objectives placed at the end of the chapter or within the chapter. Two participants preferred objectives placed at multiple locations.

How do students use self-tutorials and what are their opinions on the quality of feedback?

When participants were asked whether they completed the self-tutorials, the Likert scale responses (SA, A, N, D, SD) were (14, 5, 2, 1, 0). Twenty-one participants described how they used the self-tutorials. Six read or studied the self-tutorials, one read the self-tutorials to provide a focus for studying, 10 answered the questions, two checked their answers against the text, five used the self-tutorials in self-testing, one memorized the questions and answers, four shared answers, and two read others’

answers.

Three participants emphasized that they strived to produce detailed answers and even extra annotations so that the product would be a comprehensive study tool. Four participants used the self-tutorials as study guides or as the basis for creating study guides, or outlines and flashcards. These approaches are interesting for their creativity. Participant 3 did not create a study guide but noted, “the self-tutorials were the bulk of my studying for the course.”

When participants were asked whether the answers in the self-tutorials provided an appropriate amount of feedback, the Likert scale responses (SA, A, N, D, SD) were (10, 9, 1, 2, 0). Participants were then asked to comment on the quality of feedback, and 21 answered the question. All but one participant did try to make use of supplied feedback. The most common comment was that the feedback in the self-tutorial answers was helpful or good (10 participants). Other positive comments were that feedback was extremely helpful (one), just right (one), without extraneous details (one), sufficient (one), and especially helpful for questions not directly answered by a fact located in the text (one). Negative comments were that the answers were sometimes too brief (two) and did not explain how the answer was obtained (two), that many of the answers were too general (three), requiring more direct answers or clues (one). Four participants mentioned the balance between the provision of answers and the need for practice with one participant stating, “The answers were good because sometimes they were straightforward and others led you to the correct answer so you would understand it better.”

Do objectives increase the ease and efficiency of study and provide correct test expectations?

Twenty-two participants completed this survey section. When they were asked whether the objectives made it easier to know what they should learn, the Likert scale responses (SA, A, N, D, SD) were (9, 11, 2, 0, 0). When asked whether objectives made their study time more efficient, the Likert scale responses (SA, A, N, D, SD) were (13, 7, 2, 0, 0). When asked whether the test questions were consistent with their expectations from the course objectives, the Likert scale responses (SA, A, N, D, SD) were (13, 8, 1, 0, 0). Finally, when asked whether the test questions were consistent with their expectations from the self-tutorial exercises, the Likert scale responses (SA, A, N, D, SD) were (14, 6, 2, 0, 0). Participants were asked if aspects of objectives in the course had hindered their study. All 20 who answered this question replied ‘no’ (expressed in various ways).

Finally, when asked if any test questions were unanticipated, of the 20 participants who completed this question, five noted unexpected questions from the chapter on ocular aberrations and one stated that the questions on laboratory class topics were unexpected, and recommended more guidance to prepare for these.

Discussion

Inquiry 1. How do students actually use objectives?

Attention to objectives

Participants in this study were paying attention to the objectives, as evidenced by the strong disagreement with strategy 8 in **Table 1**. Most used them often or very often. Other estimates of students’ actual use of objectives vary widely.^{7-9,11} Mast et al. identified several factors in the use of objectives by medical students,¹³ and many of these factors were probably favorable in the current course. Nevertheless, the wide variety in students’ attention to objectives⁷⁻¹¹ suggests that the cognitive mediation paradigm¹¹ should be modified to include attention to the objective as one of its components.

Student use of objectives

A wide variety of strategies and patterns were found in this study. Some of these are consistent with published strategies^{9,12,13} (Table 1), and some are consistent with the cognitive mediation paradigm.¹¹ Participants in the current study expressed statistically significant agreement with only eight of 18 published strategies for the use of objectives (Table 1). There are not strong a-priori reasons to expect that all students everywhere should indeed all use the same set of strategies, since some strategies may be more effective than others in particular courses, programs or educational settings. As an example of the diversity in educational settings, Duchastel studied female students of a Swiss college (equivalent to U.S. grade 11 and 12),⁹ and Bassett and Kibler¹² and Mast et al.¹³ studied, respectively, communications students and medical students, at U.S. universities.

Past studies demonstrate a focusing effect of behavioral objectives: They increase instructor-specified learning, while suppressing incidental and self-directed learning.^{13,16,17,28-32} Consistent with these findings, participants in the current study did not generally formulate their own objectives (**Table 1, strategy 17**). Nevertheless, the focusing effect was incomplete: They also studied parts of the course materials not directly covered by the objectives (**Table 1, strategies 9 and 15**). This suppression of self-directed learning may be a concern to some instructors. If so, it is possible to counter the effect through

course activities such as goal-setting exercises,³³⁻³⁵ practical scenarios³⁶ and assignments, where students are encouraged to set their own learning goals.

Consistent with earlier studies,^{9,12,13} participants in this study rarely mentioned others in their descriptions of how they used the objectives or self-tutorials. However, few researchers have studied how course objectives might influence students' learning relationships and the ways in which students seek to help their peers.^{21,37}

Only a small proportion of participants reported a step-wise process for their use of objectives consistent with the order of the parts of the cognitive mediation paradigm.¹¹ Nevertheless, about half of the participants reported one or more of the parts somewhere in their responses. These results are somewhat supportive of the cognitive mediation paradigm. Furthermore, the current content analysis suggests that the components of the cognitive mediation paradigm¹¹ should be considered as parts rather than as ordered steps.

Inquiry 2. Do students have previous experience in the use of objectives?

This group of optometry students had extensive experience with both types of objectives by self-report (**Table 2**). Of concern in interpreting these data are the large standard deviations for the optometry program, where all students actually take the same courses (apart from a few students who have the option to add one or more elective courses). This suggests that participants' interpretations of the supplied definitions for behavioral and non-behavioral objectives may have varied considerably. An alternative could be for the investigator to perform a detailed analysis of the text of actual course materials. In this way, the investigator could apply the definitions for behavioral and non-behavioral objectives carefully and precisely, rather than relying on students' memories of their course syllabi.

Inquiry 3. Are there ways to present objectives to enhance learning?

A majority of participants preferred the current placement of objectives at the start of each chapter. In contrast, previous studies found best performance for objectives interspersed within the paragraphs of the text.^{14,15} Perhaps student preferences are not optimal for performance. Possibly, students in this course preferred objectives at the start of the chapter because they had not been offered alternatives. A third possibility is that the objectives in this course required the student to do more than simply look for a fact in a nearby paragraph, which would otherwise have favored in-text placement. A fourth possibility is that the advance organizer at the start of each chapter made the list of objectives more accessible³⁸ and possibly more useful.

Inquiry 4. Does completion of questions promote learning, irrespective of the ability to articulate an objective?

Practice and feedback are important components of learning³⁹ and of objectives-based curricula.^{11,18-22} It was satisfying to find that most participants were using the self-tutorials as a way to practice and to self-test, and that they tended not to rely simply on reading study group answers to objectives (**Table 1, strategy 16**). In addition, most students found the exam questions to be consistent with their anticipations from completing the self-tutorials.

Inquiry 5. Do objectives increase the ease and efficiency of discovering what should be learned?

Most participants stated that objectives made their study time more efficient, consistent with previous research.^{13,23} They also found that the objectives made it easier for them to know what to learn, in contrast to two previous studies.^{18,19} Participants could not recall any way in which objectives had hindered their study, and this is consistent with previous studies.^{13,17,40,41}

Inquiry 6. Do exam questions meet students' prior expectations of learning?

Most participants found that the exam questions were consistent with their expectations from reading the course objectives and from completing the self-tutorials. This is a useful finding because providing correct expectations has been proposed as an important rationale for the use of objectives,²⁴ and only one previous study of a genuine educational setting has asked students to rate whether exams met their expectations.¹³

Strengths and limitations of the study

Overall this study has added to the small amount of information on how students actually^{9,12,13} use supplied objectives in a genuine¹³ educational context, and it is the first to report students' prior experience with behavioral and non-behavioral objectives.

Additionally, this study's extensive content analysis of student uses of objectives suggests new directions for future research to address criticisms of earlier approaches.^{11,40-42} One new direction would be to make detailed studies of individual students

within particular educational settings. An ethnographic approach would be well-suited to this purpose.^{43,44} This is important because with the exception of Mast et al.¹³ and of the current study, researchers have wholly ignored genuine courses within genuine educational settings. A second direction for new research, suggested by Duchastel and Merrill,⁴⁰ would be to make factorial experimental studies of the complex interactions between objectives and other characteristics of the educational settings, with a view to theory development.

One limitation of this study is that although multiple, non-coercive recruitment methods were used, the resulting sample has the potential for selection bias from non-response bias.⁴⁵ This in turn potentially limits generalizations from the current findings to the whole class.

A limitation of the paper survey is that written descriptions provided by the participants may have been incomplete or the verbiage they used was difficult to interpret without further questioning. (For example, contrary to the cognitive mediation paradigm, no participants specifically mentioned 'interpreting' the objectives. Instead, they used words such as 'reading' and 'reviewing'.) More complete accounts could be elicited using interview or observational methodologies.

Although the current findings from a visual optics course in an optometry program are not formally generalizable to other courses and programs, some instructors may nevertheless wish to make use of the findings in their courses. Mast et al.'s study of medical student education may also be helpful for its analysis of several factors in the use of objectives across a healthcare curriculum.¹³ For example, students in that medical program reported that objectives were more useful in the basic science track than in pre-clinical and clinical tracks.

A new model of students' use of behavioral objectives

The descriptions of real students' actual uses of objectives in this study are quite complicated. Therefore the results of the current study were combined with those from three other studies of students' natural use of objectives,^{9,12,13} and with the cognitive mediation paradigm¹¹ to provide a model that can be tested in future studies. The components of the new model are:

1. Instructor, Course and Curriculum. When students enter a course that has behavioral objectives, various factors such as instructor emphasis,¹³ the quality (clarity) of the written objectives,¹³ and alignment of testing to the objectives¹³ can lead the students to adopt a:
2. "Doing" Orientation. The behavioral objectives lead the student to ask, "What must I be able to do?" (as opposed, say, to "What must I remember?"). With this orientation, students demonstrate:
3. Attention to the Objectives. This attentional focus is not complete, as students still engage separately in incidental learning (e.g., reading the handbook without objectives in mind). Once students attend to the objectives, the following four components of learning may be found (not necessarily in this order):
4. Interpretation of the Objectives¹¹⁻¹³
5. Goal-Directed Learning¹¹⁻¹³
6. Self-Testing to the Objectives.¹¹⁻¹³ This includes practice (e.g., completing self-tutorial exercises)
7. Constructive Learning. An example is the creation of original, personal study guides.

Conclusions

Students used behavioral objectives in a wide variety of ways, some of which are consistent with past studies and with Jiang and Elen's cognitive mediation paradigm.¹¹ It is suggested that the cognitive mediation paradigm be expanded to a seven-component model that captures the main themes of students' natural uses of objectives noted in the current study and in previous studies. Clearly written objectives that covered material emphasized in the course, along with self-tutorials made learning easier and more efficient and provided appropriate expectations of examination questions.

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Chewable Formulation of AREDS2 Vitamins



Alcon has added the SYSTANE ICAPS Chewable AREDS2 Eye Vitamin to its ICAPS line of eye vitamin formulations that are designed to support healthy eyes. The SYSTANE ICAPS Chewable AREDS2 Eye Vitamin contains ingredients used in the Age-Related Eye Disease Study 2, a clinical trial supported by the National Eye Institute that evaluated the effects of various combinations of nutrients on the progression of age-related macular degeneration. The new ICAPS are the first chewable AREDS2 formula to be available in the U.S. market.

Also: Stephen S. Lane, MD, joined Alcon as Chief Medical Officer and Global Head Franchise Clinical Strategy. In this role Dr. Lane leads the integration of scientific, clinical and commercial priorities across the company's Surgical and Vision Care franchises, with a focus on the needs of patients and eyecare practitioners. Dr. Lane also supports the generation of Surgical and Vision Care clinical evidence and represents Alcon to the academic, scientific and industry communities and government agencies.

Facebook Page Designed for Active Communication with Eyecare Professionals



Did you know Allergan has a Facebook page dedicated to enhancing the positive partnership between Allergan and eyecare professionals? At the [Allergan Optometry Facebook page](#), you can find discussions about disease states including dry eye and glaucoma, helpful patient care resources, information about upcoming events and activities, and an actively engaged company that is listening and responding to you.

Lens Personalization Reaches a New Level



HOYA Vision Care has launched [iD MyStyle 2](#) personalized lens technology and design. While the original iD MyStyle was

the first to use HOYA's patented Integrated Double Surface Design technology and incorporate patient lifestyle parameters into the design of the lens, the second-generation, iD MyStyle 2 builds on that platform with the addition of unlimited design variations, Binocular Harmonization Technology (BHT), and lens design verification.

iD MyStyle 2 lens prescriptions take into account each patient's unique needs, lifestyle and history. BHT ensures that both eyes receive equal accommodative support so that optimal binocularity can be achieved. With design verification, every iD MyStyle 2 prescription is tested and verified before it is produced using HOYA's patented Binocular Eye Model and 3D visual acuity simulation.

NEW CMO Appointed

Johnson & Johnson

VISION CARE, INC.

[Johnson & Johnson Vision Care, Inc.](#), named Jonathan Talamo, MD, as its new Chief Medical Officer (CMO) and Worldwide Vice President of Medical Affairs and Clinical Affairs for Johnson & Johnson Vision, which comprises both the Vision Care and Surgical businesses.

Dr. Talamo previously served as CMO for Ocular Therapeutix, Inc., a public biopharma company. Prior to assuming that position, Dr. Talamo owned a private practice for nearly 20 years, specializing in refractive surgery, cataract surgery and corneal transplantation. He has written more than 80 peer-reviewed publications, review articles and book chapters; he lectures worldwide on topics related to corneal disease, cataract and refractive surgery; and he has received Honor and Senior Achievement awards from the American Academy of Ophthalmology.



Jonathan Talamo, MD

New Z-Type Slit Lamp Digital Tonometer

Keeler
Ophthalmic Instruments

Keeler has expanded its range of tonometers with the D-KAT Z-type, the first digital applanation tonometer designed for Keeler Z Series slit lamps and other lower illumination style slit lamps. The D-KAT Z-type has fewer moving parts than

conventional applanation tonometers, and its internal electronics deliver fast and accurate IOP measurement to one decimal point. The integrated LED display is easy to read in darkened exam rooms. In addition, Keeler offers the Tonomate disposable applanation prism for use with the D-KAT Z-type. Sterile, and individually packaged, Tonomate prisms are designed to be discarded after use, streamlining eye examinations and reducing the risk of infection transmission.

For more information, visit the [Keeler Ophthalmic Instrument website](#), [e-mail the company](#), call (800) 523-5620, or contact an authorized dealer.

Optometrists' Service Milestones Recognized



At an awards dinner held during its Annual Continuing Education Symposium, June 3-6, 2017, in Chicago, [National Vision Inc.](#) recognized 115 optometrists affiliated with the company for service milestones ranging from five to 25 years.

According to National Vision CEO Reade Fahs, "For the past decade our North Star has been that National Vision is striving to create environments where great optometrists want to spend their entire career. This special group of optometrists, who have spent their career with us, is a testament to the sort of talented, caring optometrists that make up our community at National Vision. We congratulate these doctors on their achievements, and thank them for making it possible for us to live our mission of making eye care and eyewear more affordable and accessible to all Americans."

Campaign Educates Consumers about UV and Blue Light



To bring its new advertising campaign Live the Good Light to life for consumers in 2017, Transitions Optical launched the [Good Light Project](#) — an initiative that illustrates the role changing light plays in shaping our days and nights, and some of our most memorable moments. The company is introducing eyeglass wearers to the Good Light Project online and on social

media and by partnering with influential Transitions lens wearers, including actress [Jamie Chung](#). The company says a goal of the Good Light Project is to inform consumers how Transitions lenses can help “protect the eyes from both UV and harmful blue light so that we are able to embrace the goodness found in light and live life to the fullest.”