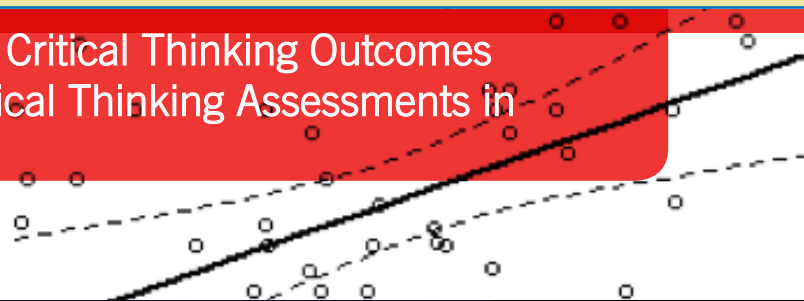


OPTOMETRIC EDUCATION

Volume 39, Number 3

Summer 2014

Investigation of an Additional Critical Thinking Outcomes Measure: The Efficacy of Critical Thinking Assessments in Predicting Clinical Success

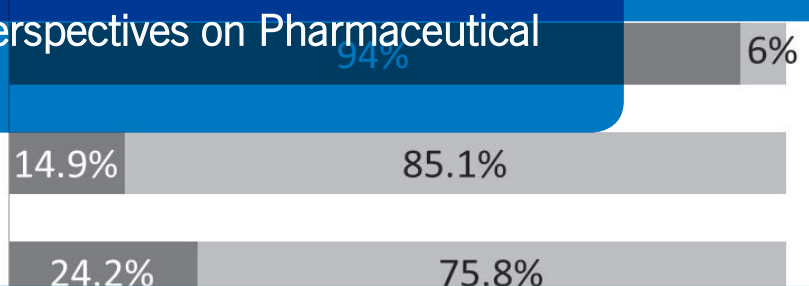


Ocular and Generalized Myasthenia Gravis: A Teaching Case Series



Optometry Students' Exposure to and Perspectives on Pharmaceutical Industry Gifts and Interactions

Drug companies provide gifts to optometrists in an effort to give back to the profession. The majority of patients are aware that



Traumatic Hyphema: A Teaching Case Report

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2014 Recipients of ASCO Starter Grants for Educational Research

Educator's Podium: Assessment in Higher Education

ASCOTech: Avoiding Death by PowerPoint: Can We Improve Our Use of This Now Ubiquitous Teaching Tool?

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Now Available through Google Scholar!

Optometric Education can now be accessed using Google Scholar. The process of indexing past issues at <http://scholar.google.com/> is ongoing.

The current edition of the journal, as well as all past editions, can be found on the ASCO website at <http://journal.opted.org/>. Funding for the archiving was generously provided by Transitions Optical.

OPTOMETRIC EDUCATION is published by the Association of Schools and Colleges of Optometry (ASCO). Managing Editor: Desiree Ifft. Graphic Designer: Kerri McTigue. Business and editorial offices are located at 6110 Executive Boulevard, Suite 420, Rockville, MD 20852; (301) 231-5944. *Optometric Education* is published three times per year. To access *Optometric Education* online, please go to www.opted.org.

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INDUSTRY NEWS

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

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Review of Optometry

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**University Dedicates
Essilor Student Center**

essilor

Seeing the world better

A dedication ceremony for the Essilor Student Center at Marshall B. Ketchum University (MBKU) was held this June on the university's Fullerton, Calif., campus. The naming of the Student Center, along with the Essilor Conference Center at the university's Eye Center at Los Angeles, is in recognition of the corporation's history of support to the institution.

"Essilor has a long-standing record of social and financial support to the Southern California College of Optometry at MBKU," said university President Kevin L. Alexander, OD, PhD, in a press release. "Their recent pledge of \$250,000 to the university's ACHIEVING 20|20 Campaign boldly endorses our vision to reimagine the future of health care through the expansion of educational programs and strengthens our partnership."

At its Shared Visions Gala on October 2, 2014, MBKU will present Essilor with its V-Award for Corporate Humanitarian Service to honor the company's support of charitable organizations across the United States and around the world, which has touched the lives of thousands of people and left a lasting social impact.



Pictured from left to right: Kevin Alexander, OD, PhD, President of Marshall B. Ketchum University; Julie Schornack, OD, MEd, Vice President for Clinical Affairs, Southern California College of Optometry at Marshall B. Ketchum University (SCCOMBKU); Bob Colucci, Chairman of the Board, Essilor Vision Foundation; Ms. Tiffany Chen, incoming President of the SCCOMBKU Student Association; Rod Tahran, Vice President of Professional Relations and Clinical Affairs, Essilor of America; and Stanley Woo, OD, MS, MBA, SCCOMBKU Dean.

*As of June 1, 2014

Dr. Lee Steps into Student-Focused Role



Charissa Lee, OD, has been appointed to the position of Director, Education, Johnson & Johnson Vision Care Inc. (JJVCI) North America. In this role, Dr. Lee leads the development of programs supporting the schools and colleges of optometry across the United States.



Charissa Lee, OD

"Johnson & Johnson Vision Care is committed to supporting the education of the next generation of optometrists," commented Millicent Knight, OD, Head of Professional Affairs, JJVCI. "With the addition of Dr. Lee to our Professional Affairs team, we look forward to working even more closely with optometry schools to provide students with additional tools and resources they need to become effective, successful practitioners."

Prior to joining JJVCI, Dr. Lee served as a Professional Affairs Consultant to the company, whereby she regularly educated optometric practitioners on clinical issues and practice management strategies. Since 2012, she

has served as Program Director and lecturer for educational events at The Vision Care Institute, LLC.

Pro-Optometry Video Gains Supporters



The Allergan Foundation has awarded a competitive Focus Grant to the Association of Schools and Colleges of Optometry (ASCO) to support the "Be a Doctor of Optometry: Put Your Future in Focus" video. The Allergan Foundation joins Luxottica in supporting ASCO's initiative to promote the Doctor of Optometry profession.

The video, available on the association's YouTube channel (www.youtube.com/channel/UCmws13yqQhOpSl-R2qKjxizQ) and through its website, is the latest marketing tool developed for the ASCO/American Optometric Association Joint Project of Further Developing a Robust, Diverse, and Highly Qualified National Applicant Pool. The video complements the True Stories booklet and other information and resources at the ASCO website, www.opted.org.

Industry Veteran Sattler to Retire



Dave Sattler will retire from Alcon in August, after 28 years of service. His most recent role with the company has been overseeing academic development for US Vision Care as Director of Professional Relations. According to Alcon, while holding this position Sattler strengthened the company's ties to optometry schools and colleges. He also worked with the Alcon Foundation, the city of Fort Worth and two optometry schools in Texas

to help establish an eye clinic for the underserved in downtown Fort Worth.

"I have had 28 great years with Alcon, but I am most proud of the eyecare now being provided to the local underserved patient population through the establishment of the Fort Worth Community Eye Clinic," Sattler said in a press release. "This program brings together our local city government, optometry schools and Alcon to make a real difference in patients' lives."

Sattler's career with Alcon began in 1986 when he was hired as a sales representative in San Diego, Calif. His colleague Rick Weisbarth, OD, FAAO, Vice President of Professional Affairs for US Vision Care, commented "Dave is one of the most respected industry professionals in the eyecare field. It was my pleasure to work side-by-side with Dave for so many years as his passion for eye care is unmatched in the industry."

Tom Duchardt is expected to step in to lead the academic development initiatives for Alcon US Vision Care following Sattler's retirement.

Research Explores Issues of Diversity



Transitions Optical Inc. recently released results of research it commissioned to explore the attitudes and actions of eyecare professionals (ECPs) in the area of serving culturally diverse patients. While 96% of ECPs reported they serve culturally diverse patients, far fewer are taking steps to actively meet their needs, according to a survey* conducted in March. The survey found that two-thirds of ECPs do not use bilingual or in-language resources, half do not employ a diverse or bilingual staff, and three-fourths do not participate in community outreach activities targeting ethnic populations. All of these efforts are important to culturally diverse consumers — and can be a differentiator in an eyecare professional's ability to attract and retain diverse patients — according to separate consumer research** supported by the company.

The March survey also explored how ECPs treat and communicate with patients who have systemic health conditions, such as diabetes and hypertension, which are more common among ethnic populations. According to Transitions, results revealed a need for enhanced patient education and an opportunity for increased collaboration with general

healthcare providers to improve overall patient care.

Transitions Optical makes a variety of resources designed to help ECPs better serve their culturally diverse patients available free of charge through MyMulticulturalToolkit.com.

** Online survey of 241 eyecare professionals conducted by Jobson*

Optical Research on behalf of Transitions Optical, Inc. from March 19-24, 2014.

*** Online survey of 1,000 nationally representative Americans 18+, with oversamples of up to 400 interviews among African American, American Indian, Asian American and Hispanic subgroups, conducted by Wakefield Research on behalf of Transitions Optical, Inc. in February 2013.*

Changes to Editorial Review Board

Optometric Education would like to thank three members of its Editorial Review Board who have recently completed their terms. Nancy Carlson, OD, is retiring from the New England College of Optometry. Sara Bush, OD, has accepted a new position at the Michigan College of Optometry at Ferris State University. Michelle Welch, OD, is making a career change.

We greatly appreciate the time, effort and expertise they have contributed and the contributions they have made to the development of the professional literature and to the quality of the journal in their roles as members of the Review Board.

The journal welcomes Erik Weissberg, OD, Professor at the New England College of Optometry, as the newest member of the Review Board.

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EDITORIAL

What are the Characteristics of a Manuscript Acceptable for Publication?

For the best chance of success, authors should avoid these five shortcomings.

Aurora Denial, OD, FAAO



Scholarship can be defined as the “creation, discovery, advancement or transformation of knowledge.”¹ The knowledge is then evaluated by peer review and made public.¹ The peer review process is designed to ensure publications of the highest quality. This process evaluates research design, analysis of data, conclusions, discussion, etc. Experts within a topical area

may review with full identification of the author or blindly depending on the protocol of the individual journal. The journal editor usually has the final opinion on acceptance or rejection of a manuscript while taking into consideration the reviewers’ recommendations. Most times acceptance is contingent on revisions of the article. Acceptance/rejection rates can vary depending on many factors, including size limitations in relation to online vs. print journals, topical areas for general vs. specialty journals or size of the profession. A journal’s acceptance/rejection rate is sometimes posted on its website. The *New England Journal of Medicine* posts a 5% acceptance rate, and the *Journal of the American Medical Association* posts a 9% acceptance rate.^{2,3}

Understanding a journal’s philosophy, readership, acceptance rate and demographics can be helpful in deciding where to publish and the likelihood of success. This brings us to the question “What are the characteristics of a manuscript that is acceptable for publication?” To provide insight into the peer review and publication process, I have listed the five most common reasons manuscripts initially get rejected by *Optometric Education*: poor study design, lack of scholarly qualities, information not relevant or new, inappropriate or incorrect analysis or interpretation of data, and poor writing. In some cases the concerns are fixable and the manuscript will get a second chance with a successful outcome.

1. Poor Study Design

Poor study design can involve many different aspects of a project. A methodology that is not sufficient to investigate the hypothesis is the most common. This may include a lack of a control group, lack of specificity or clarity in the methodology, or outcome assessment that reflects only students’ satisfaction. Student satisfaction surveys are important in determining students’ perceptions but can be controversial when trying to demonstrate learning. The use of student surveys in addition to other outcome measures for learning tends to produce more reliable results. A successful manuscript is one that reflects a high-quality study and research design. Therefore, consult with as many experts as possible when in the design phase of any project. The goal is to prevent a weak or poor experimental design, which is not fixable after the project has been implemented.

2. Lacks Scholarly Components

A lack of scholarly components is another common reason a paper would not get accepted for publication. Scholarly elements may include novel insights, interpreting themes in discoveries, identifying connections between discoveries, linking theory and practice, or comparisons or analyses of teaching methodologies. A successful manuscript reflects scholarly elements that are linked to past and current scholarly work.

3. Not New, Innovative or Impactful

Information that is not novel or new may not be worthy of publication. The important questions of “so what?” and “who cares?” must be considered when designing a project. The potential impact and generalizability of the project will help to answer those questions. A literature search that demonstrates a lack or paucity of information can be helpful in demonstrating novelty of a project. In the writing phase, the

authors must clearly and obviously explain to the readership why the topic and project are important. Brainstorming with colleagues to make sure your project will answer the questions above is important because this is not fixable after the project has been implemented.

4. Inappropriate Data Analysis

Inappropriate or incorrect analysis of data often leads to results and conclusions that may not be accurate. Misinterpretation of data may lead to conclusions that are ambiguous, not supported by the data, or fail to consider alternative explanations. Consultation with a statistician and colleagues knowledgeable in the area being studied can help resolve this issue before the review process and lead to a more favorable outcome.

5. Poor Writing

Poor writing includes a lack of clarity, poor spelling and grammar. This can be very distracting to reviewers and negatively impact the review. Although this is a very common issue, it is also one that is most easily fixable. Most articles

published in *Optometric Education* are submitted by optometric faculty. Therefore, utilize your colleagues to review a manuscript before sending it out. It is often also helpful to have the manuscript read by a lay person who can comment on the clarity and organization of the paper from a different perspective. Authors rarely are able to spot deficiencies in their own writing.

Make the Best of an Opportunity

In summary, to increase the likelihood of success in publication, consult with a design/statistical expert upfront, read the journal of intended publication, provide concrete evidence for relevance and novelty, ensure the paper includes scholarly elements, and have both a lay person and expert review the manuscript before sending it into the journal.

Contributing to the optometric education literature is a tremendous opportunity to serve the profession and improve individual skills as a researcher and writer. Peer reviewed publications support the growth and evolution of the profession.

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2. New England Journal of Medicine, Information for Authors. [cited May 30, 2014] Available from: <http://www.nejm.org/page/author-center/publication-process>.
3. Journal of the American Medical Association, Why Publish in JAMA? [cited May 30, 2014] Available from: <http://jama.jamanetwork.com/public/WhyPublish.aspx>.

Don't Miss It

Between now and August 1, watch your Inbox for the announcement that the Summer 2014 issue of ASCO's newsletter *Eye on Education* is available.

In addition to the news from ASCO, the schools and colleges and industry that you've come to expect, the issue will include insights from ASCO leaders as they discuss the recently released findings of the AOA/ASCO National Eye Care Workforce Study.

In the meantime, visit the ASCO Newsroom at <http://www.opted.org/newsroom-media/> to read top-line results from the study and learn how to obtain a digital or printed copy of the findings.

Assessment in Higher Education: The Newest Frontier

Steven H. Schwartz, OD, PhD

*Dr. Schwartz is a Professor and Director of Institutional Research and Planning
at State University of New York, College of Optometry*

While there is disagreement in Washington on just about everything else, politicians of all persuasions appear to have found common ground on an issue that is at the heart of what we do as educators. There is a widespread belief that institutions of higher education must be made more accountable to the public.

Unlike in Europe, American institutions of higher education are not accredited by the government, but by independent accrediting agencies that are recognized for this purpose by the federal government. It is through these agencies and the potential threat of increased intervention in their affairs that the federal government has exerted pressure on the nation's institutions of higher education to demonstrate increased accountability. Importantly, an institution must be accredited by a recognized agency for its students to receive federally supported loans.

In response to concerns expressed by the federal government, accreditation agencies are placing increasing emphasis on planning and assessment. This is particularly true for regional accreditation agencies such as Middle States Commission on Higher Education (MSCHE), which provides regional accreditation of SUNY College of Optometry.

Heightened scrutiny of planning and assessment is rapidly changing the manner in which institutions implement and design these processes. Gone are the days when a strategic plan post-

ed on an institution's website and a few associated data points will suffice. Regional accreditation agencies are now calling for strong linkage between planning, collection of outcomes data, analyses of these data, and perhaps most critically, the use of these analyses for program improvement. The term "closing the loop" has come to characterize the heightened expectations of accreditors. Data must not only be collected, it must be used for program improvement. Furthermore, it is the institution's responsibility to demonstrate that this is the case.

One does not need to look very hard for evidence that regional accreditors are serious about assessment. In recent years, the primary reasons for mandatory MSCHE follow-up reports relate to Standards 7 (institutional assessment) and 14 (assessment of student learning). As reported in its April 2013 newsletter, the Commission required follow-up reports from 39 out of 55 institutions that submitted self-studies in 2012. Forty-two percent of the institutions were required to submit a follow-up report on assessment of student learning and 40% on institutional assessment.

At just about all universities and colleges, an office of planning and assessment, often tied to institutional research, coordinates and oversees these processes. These offices are usually headed by a full-time director who often holds a doctorate in a related field. Depending on the size of the institution, its complexity and the value it places upon

planning and assessment, the office is staffed by a number of analysts who assist the director.

The increasing importance of assessment potentially adds another financial burden to the already stressed budgets of optometric institutions. In this paper, I detail how the SUNY College of Optometry has responded to the heightened expectations for assessment through the development of a cost-effective program designed for this purpose.

Office of Institutional Research and Planning

Planning and assessment are the primary responsibility of the Office of Institutional Research and Planning, which is charged with supporting institutional decision-making and planning through the collection and analysis of data. As part of its responsibilities, the office:

- Produces *Factbook*, an online compendium of College key indicators
- Oversees the reporting of data to external agencies
- Serves as the College liaison to regional and professional accrediting bodies
- Oversees institutional accreditation processes
- Facilitates the strategic planning process
- Monitors the implementation of the College's strategic plan
- Facilitates the administration of

alumni, faculty and student surveys

- Conducts and oversees ad hoc studies that use data to inform issues of institutional importance.

The office is staffed by a full-time faculty member who dedicates about 50% of his effort to related responsibilities, holds the administrative title of director and in this capacity reports directly to the president. Support staff in the Office of the President is available to assist in scheduling meetings and distributing documents. More specifically, the director is expected to:

- Coordinate all research activities relating to the study of the College as an institution
- Serve as Chair of the Committee on Institutional Research and Planning (CIRP)
- Oversee the development and implementation of the outcomes assessment program for the strategic planning process
- Serve as the institutional liaison to educational accreditation agencies including the Middle States Commission on Higher Education and the Accreditation Council on Optometric Education
- Work with the College community to identify needs for information and problems for investigation, coordinating faculty participation in institution studies
- Conduct research to answer questions of an institutional nature which are required by administrative officers
- Supervise the collection, analysis, and preservation of data for use by the institution in studies of university policies and operation
- Develop a comprehensive data base for utilization in responding to inquiries from the Central Administration and external agencies
- Coordinate the provision of data and reports to SUNY System Administration and to external agencies including IPEDS, ACOE, MSCHE and ASCO.

As an independent campus of SUNY, the College of Optometry must not only comply with the programmatic

accreditation standards of the Accreditation Council on Optometric Education, it must also adhere to those of MSCHE as well as comply with various reporting requirements and regulations of SUNY and the state and federal governments. Optometry programs that are part of a regionally accredited institution may require less time and effort dedicated to accreditation functions.

The Committee on Institutional Research and Planning, which is appointed each year by the president, is chaired by the director. It is broadly constituted of faculty and staff members to represent various operational units of the College. The committee is advisory in nature and meets about six times during an academic year.

Institutional Research Webpage

The assessment process results in the accumulation of substantial amounts of data and numerous reports. To facilitate access to this information, the College has developed a public webpage dedicated to this purpose (http://www.sunyopt.edu/offices/institutional_research). This page contains links to:

- A description of the Committee on Institutional Research and Planning
- *Factbook*, a compendium of College key indicators
- The College' assessment plan
- Annual IPEDS reports
- Annual institutional goals
- Presentations at Annual Implementation Meetings
- Results of various College surveys
- The College's most recent self-study along with the accreditors' evaluation report
- Certificates of accreditation
- The College president's annual State of the College addresses.

Factbook, which longitudinally tracks the College's key performance indicators, is updated annually. It consists of about 68 separate figures in PDF format, most of which are accessible to the public. Figures generally present data for several years in graphical and tabular form.

The PowerPoint slides used to generate the PDF figures in *Factbook* are posted in a folder on the College's email system that is accessible to upper-level management. In the fall of each year, the vice presidents and their staff update the slides with the most recent year's data. The new slides are compiled by the director, formatted for uniformity, converted to PDF files and posted on *Factbook*.

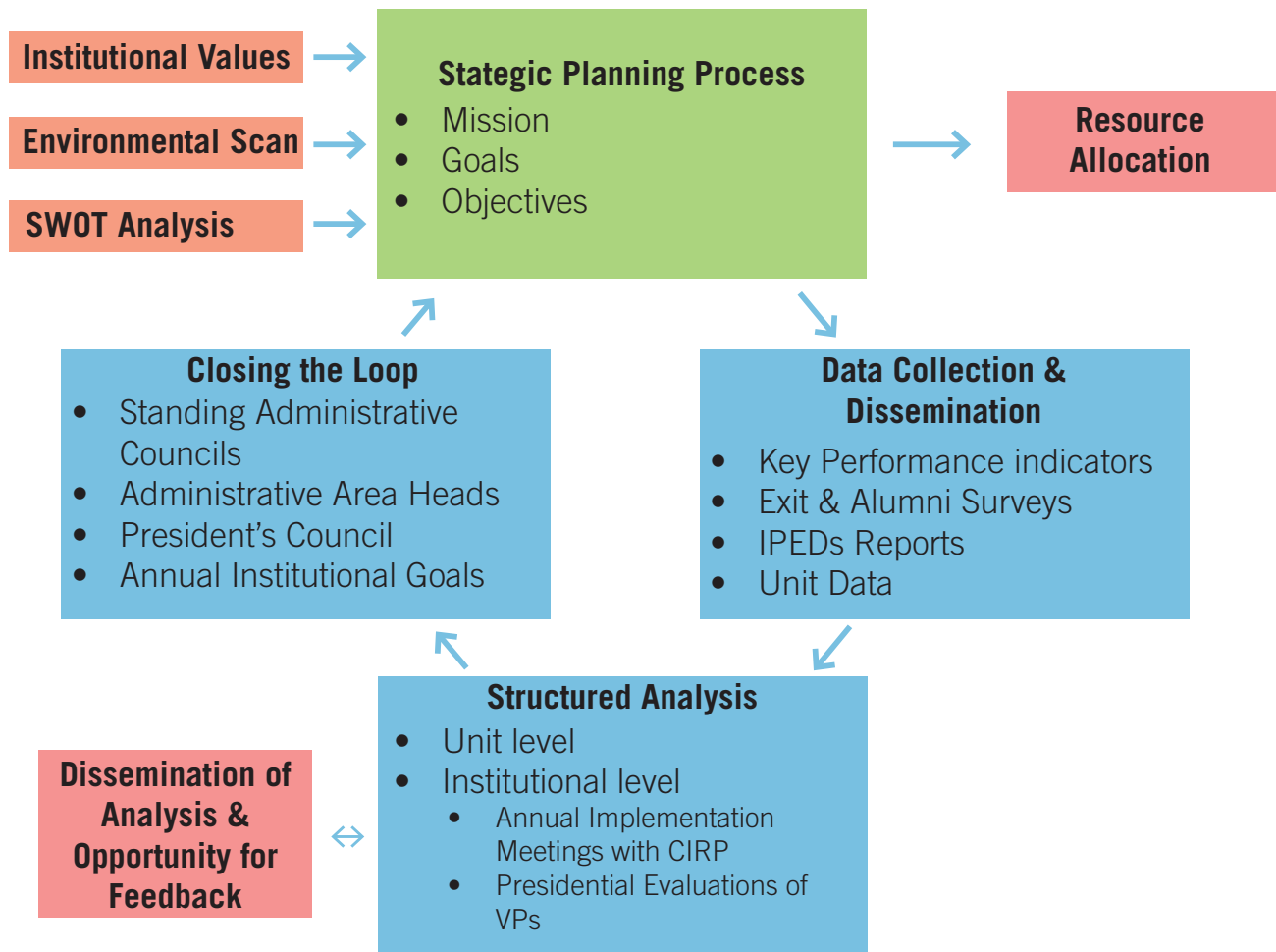
Institutional Assessment Plan

The College has developed a formal written assessment plan that is published on its Institutional Research webpage (http://www.sunyopt.edu/pdfs/institutionalresearch/Assessment_Plan.pdf). Various assessment strategies are used to track implementation of the College's strategic plan and monitor College operations. The primary motivation is to identify, obtain, analyze and utilize outcomes data for meaningful programmatic improvement. When available and appropriate, national data serve as benchmarks for assessing performance. Analysis of data may lead to corrective actions when they are not consistent with expected outcomes.

As illustrated in **Figure 1**, institutional assessment is ongoing and may be conceptualized as a cyclical process that starts with the establishment of strategic goals and objectives. Institutional key performance indicators, which are quantitative indicators of progress relative to the strategic plan, are tracked longitudinally; assembled by the Office of Institutional Research and Planning; published on the College's website (http://www.sunyopt.edu/offices/institutional_research/factbook); and updated annually.

Key performance indicators and other data are utilized by the College vice presidents to analyze progress in their respective areas. These analyses are presented to the Committee on Institutional Research and Planning and senior management team at Annual Implementation Meetings (AIMs). The presentations are also published on the College's website. When analyses reveal shortcomings in attaining institutional goals, corrective actions are initiated by the appropriate administrative unit.

Figure 1
Planning and Assessment Cycle



We have found it useful to distinguish between the functions of data collection and dissemination; structured analysis; and closing the loop. It is through the consideration and analysis of collected data that challenges (and strengths) can be identified and strategies and plans formulated to ensure that the strategic plan is effectively implemented. To close the loop between the aspirational outcomes of the strategic plan and the outcomes data, analysis of the data and the possible development and implementation of corrective actions are required.

In addition to annual AIMs where the vice presidents present an analysis of progress relative to the strategic plan, the vice presidents also meet annually with the president to assess progress. These meetings result in the development of annual institutional

goals that are derivative of the strategic plan, widely disseminated to the College community and posted on the IR webpage (http://www.sunyopt.edu/offices/institutional_research/annual_institutional_goals). The annual institutional goals are implemented through the College's various administrative councils and area heads.

Summary and Conclusions

Under pressure from federal regulators, post-secondary educational accrediting agencies will undoubtedly continue to heighten scrutiny of planning and assessment processes. The institutional burdens associated with these processes can be substantial absent a framework that recognizes the expectations of accrediting agencies and addresses them directly and efficiently. I see the following actions as elemental to meeting

these expectations:

- Designate an individual to be responsible for planning and assessment. This can be a part-time faculty assignment that includes related responsibilities (e.g., chairing strategic planning and self-study committees and preparing reports for accrediting agencies).
- Develop quantitative outcome measures, linked to the institution's strategic goals that can be tracked longitudinally.
- Create a mechanism that (1) facilitates wide access to the institution's outcome measures and (2) allows timely updating of this information. A dedicated webpage can be ideal for this purpose.
- Provide mechanisms to "close the

loop” by assigning responsibility to extant administrative structures to analyze outcomes data and take corrective action as indicated.

To be effective, planning and assessment requires the support of a broad segment of the institution’s community. Outcomes data must be collected by individuals with responsibilities in the areas of student affairs, patient care, institutional advancement, administration and finance, academic affairs and research. These data must be analyzed by department and area heads to determine if the institution’s strategic goals are being met, and these same individuals must implement policies or actions when this is not the case. In a broader sense, the entire community needs to understand the importance of strategic planning and assessment in order to give life to these processes.

A common theme at professional meetings attended by planning and assessment officers is institutional resistance. Although the reasons for this resistance are numerous, they are generally related to:

- An absence of enthusiasm for the process by the institution’s leaders
- A failure to educate the community on the necessity of planning and assessment and the opportunities they afford individuals, administrative units and the institution to optimize potential
- The absence of readily understood processes.

It should not be surprising that development of a comprehensive planning and assessment program requires considerable planning itself. To encourage buy-in, program development should

involve a broad segment of the community, including administrators, faculty, staff and students. The development process needs to be led by an individual who understands the requirements of accrediting agencies and can fashion a program that fits the institution’s particular circumstances. Support from the institution’s leadership is essential.

While I have emphasized the role of accreditation in prompting the development and utilization of planning and linked assessment processes, the benefits extend far beyond meeting accreditation standards. The proper use of planning and assessment allows an institution to articulate its future, determine if it is on course to fulfill this future and correct its course when necessary. It allows for the optimization of resources in support of institutional aspirations.

INVITATION TO PARTICIPATE in an Upcoming Theme Edition

Interprofessional Education (IPE)

Optometric Education is announcing a future theme edition, which will focus on all aspects of interprofessional education. The deadline to submit articles for this theme edition is Aug. 30, 2014.

For additional information about the theme edition, contact Aurora Denial, OD, FAAO, at deniala@neco.edu.

EDUCATOR’S PODIUM Submission Guidelines

Educator’s Podium is an opinion-based, nonpeer-reviewed forum for optometric educators to share, think and question within any area related to the educational process or improving patient care. Send submissions (500-1,500 words) and a 150-word synopsis for Facebook to journal Editor Dr. Aurora Denial at deniala@neco.edu.

Avoiding Death by PowerPoint: Can We Improve Our Use of this Now Ubiquitous Teaching Tool?

James Kundart, OD, MEd, FAAO, FCOVD-A

Dr. Kundart is the Immediate Past Chair of the Educational Technology Special Interest Group for the Association of Schools and Colleges of Optometry. He is a researcher and author and an Associate Professor at the Pacific University College of Optometry. He can be contacted at (503) 352-2759 or kundart@pacificu.edu.

It's no wonder our students often compare optometry school to a marathon rather than a sprint. The countless hours they spend in teaching labs, studying and practicing their clinical skills are rivaled by the thousands of hours they attend lectures. At the Pacific University College of Optometry (PUCO), where I teach, lecture time approaches 2,000 hours for the three didactic years of our curriculum. The vast majority of this time is spent learning from lectures in PowerPoint, a term used generically here to refer to the popular Microsoft software as well as similar platforms like Google, Keynote or Prezi. It is not unusual for the electronic "slide count" to exceed 10,000 for the first three years of optometry school. Our PUCO class of 2014 actually counted and came up with that number.

These sobering facts take on a different quality from the perspective of optometric educators. While we are passionate about and skilled at what we do, most of us have not had formal training in teaching, much less in making and delivering effective PowerPoint presentations. We all know good ones (and bad ones) when we see them, but many of us were trained on the job and may have started teaching in the days of analog slides and overhead projectors. Younger optometrists may not remember that photographic slide trays were still the norm at professional meetings into the mid-'90s, when laptop computers became ubiquitous and PowerPoint

became, arguably, the *prima lingua* of scientific communication.¹

Since PowerPoint software was originally developed for business presentations 30 years ago, it has swept both higher and continuing education, especially for large audiences. Microsoft calculated in 2001 that 30 million PowerPoint presentations were produced daily. This was about one for every eight computers, and there is every indication that both statistics have increased exponentially.¹ As with many technological advances, this is in part due to practical reasons, including the lower cost, higher resolution and ease of file sharing of digital presentations. There are also sound educational reasons involving the superiority of visual over auditory memory for most in the audience. Last, but far from least, our students who are signing up for those 2,000 hours of optometric education might argue that a well-constructed PowerPoint lecture is more memorable because it is more engaging than other methods, including whiteboard use or chalk and talk.²

PowerPoint is here to stay, so it behooves the optometric educator to know what the evidence shows about optimizing its use. Only in the past decade has the literature even begun to address the subject of best practices in the use of PowerPoint in education. What follows is a summary of several representative Medline articles on the subject that have explored what is most and least effective in PowerPoint lecture design, preparation and delivery.

Potential PowerPoint Presentation Flaws and Failures

Expert in the study of memory, the field of psychology has a unique perspective on the use of PowerPoint in higher education. Kosslyn and colleagues, in a collaborative study between Stanford, the University of Amsterdam and Harvard, found that the average PowerPoint presentation violates eight psychological principles, and audiences notice this, though they are not as accurate in identifying which slides in a particular presentation do so.³

The authors group these eight principles into the filters of memory encoding, working memory and long-term memory processes as follows:

1. Discriminability
2. Perceptual organization
3. Salience
4. Limited capacity
5. Informative change
6. Appropriate knowledge
7. Compatibility
8. Relevance.

The idea is a student will not know how to encode to memory a PowerPoint slide that is not visible (discriminable), organized and relevant (salient). The authors include many detailed facts involving visual perception, including contrast, spatial frequency, orientation channels and chromatic aberration. In

short, the layout of a slide should be clean and pleasing to the eye.

If the slide succeeds in being encodable, the working memory filters must be overcome next. However, it is well known that working memory has a very limited capacity of about four chunks of separate information. These chunks need time to sink in, and information that does not convey an informative change will be ignored. Fortunately, this amount of information can be held neatly on a single PowerPoint slide. When it cannot, up to four subcategories can be chunked on the next slide.

Lastly, the authors point out, a successful PowerPoint slide needs to pass the long-term memory filters. The knowledge it attempts to convey must be appropriate and relevant to the audience, compatible with them. This means the students need to be familiar enough with the material presented to make sense of it, and images on the slide have to match the text and verbal presentation. Finally, the information has to be compatible, or clinically relevant in the case of our students.

In a very readable manuscript, Southwick discusses a problem with medical students forgetting their second-year microbiology by their fourth graduate year.⁴ This was attributed to the standard teaching techniques involving PowerPoint lectures and multiple-choice exams that created a reduced reliance on the use of medical textbooks. In fact, fewer than 25 textbooks were purchased for a class of more than 100 students, with less than 2% reporting they actually used it on a regular basis.

To address this problem, the authors replaced the passive approach with active learning techniques, including

Just-in-Time Teaching (JiTT), whereby current student questions helped to shape the format of daily lectures. Peer instruction was also used, whereby students who had better comprehension would explain unclear concepts to their classmates. In addition, “essays and short-answer questions were combined with multiple-choice questions to improve understanding and recall.” These measures served to increase the use of the textbook to almost 80%. More importantly, scores in microbiology on the national board exam increased from the 59th percentile over three previous years to the 83rd percentile in the subsequent year.

Tips for Effective PowerPoint Use: All Learning is Limbic

Those of us who constantly make (and remake) PowerPoint presentations have undoubtedly given a lot of thought to ideal design. Speaking styles differ, but some PowerPoint formats are definitely more effective than others. Personally, I have changed from alternating entirely illustrated and entirely text slides to single-illustration slides with greater use of the presenter notes, which are visible to my students but not on the big screen. Perhaps the hardest thing for me to do is temper my teaching about interesting topics in vision science that are not relevant to the primary-care clinician. Other times, I must find their relevance.

In the *American Journal of Neuroaudiology* in 2011, Castillo recognizes the objections to PowerPoint format, such as reducing complex topics to simple bullet points that are potentially “detrimental to decision-making.”⁵ However, noting it is here to stay, he includes the

following PowerPoint tips in his editorial:

- Use a simple, solid background
- Use high-contrast, simple fonts
- Use no more than four bullet points of text
- Use graphs instead of tables
- Use high-definition images, and credit sources
- Avoid animations and long videos
- Design slides to last 45 seconds each
- Proofread for typos and continuity
- Never run over your allotted time.

Notice the trend toward simplicity in PowerPoint presentations. Many seasoned presenters have overcome the initial thrill of animations and fancy transitions in their lectures, the overuse of which has been called “PowerPoint-lessness.”⁶

Notably, the style of delivery makes a difference in PowerPoint effectiveness as well. Castillo quotes Dr. James Smirniotopoulos, writing that “all learning is limbic.” In other words, while attention can be commanded with fear (usually of exams), it is more sustainable to command it with humor.

Future Directions

In his efforts to improve board scores via his microbiology class, Southwick⁴ used 10 basic principles of good teaching that had been put forth by Zemelman et al⁷, which are:

1. Encourage contacts between students and faculty
2. Develop reciprocity and cooperation among students
3. Use active learning techniques
4. Provide prompt feedback
5. Emphasize time on task
6. Communicate high expectations
7. Respect diverse talents and ways of learning
8. Emphasize higher-order thinking and learning
9. Emphasize key concepts and principles
10. Study a small number of topics deeply.

“It is not unusual for the electronic “slide count” to exceed 10,000 for the first three years of optometry school.”

There is clearly more to be done with the scholarship of teaching and learning with regard to optimizing face-to-face course presentation. Yet one thing is clear: We owe it to our students to find a middle road between spoon-feeding and force-feeding. This involves getting students ready to learn when they arrive in class, or offering alternative methods like podcasts when that fails. If we can find that middle road, we won't cause death by PowerPoint, but instead will see our students and our profession thrive. I leave you with this quote:

"A great lecturer speaks to the audience and not to the slides."

Dr. Robert Quencer, Editor Emeritus of the *American Journal of Neurology*.

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Appendix A: Student Perceptions of PowerPoint vs. Other Techniques

An important aspect of exploring how best to use PowerPoint in optometric education is figuring out our students' attitudes toward it, including relative to other teaching techniques. Several studies, such as the three described here, have addressed this, producing some mixed results.

As we know, dental school has some similarities to optometric education. The admission tests in the United States are similar enough in content that the OAT and DAT used to share the same preparation books. Thus, despite cultural differences, a study done at Manipal University in Mangalore, India,¹ may have pertinence to optometric education. In the study, 2,680 undergraduate students were surveyed with 10 closed-ended questions regarding their preferences in lecture and examination format. Using e-mail and follow-up postal mail, 1,980 responses were collected, an impressive response rate of almost 74%. In response to a question about PowerPoint, 63% of the students reported they preferred it (or chalkboard lectures) over demonstrations. Clearly the PowerPoint format mattered to these students. (Other interesting findings were the overwhelming student preferences for required class attendance [75%] and for lecture handouts to be distributed afterwards [83%].)

These results were not replicated as recently as 2010 in a different dental

school in India, where technology setup time, and perhaps availability of quality digital images, made overhead projector and chalkboard lecturing more popular. Forty-four dental students (31 females, 13 males) completed a survey, with more than 74% preferring non-PowerPoint methods.² However, a total of 62 medical students (40 males, 22 females) at the same institution had no such objections, with almost two-thirds preferring PowerPoint. While no gender breakdown was made, it is interesting to note the almost perfect correlation to it in both cases, with the percentage of male dental and medical students matching the PowerPoint preference rates.

Lecture vs. PowerPoint Podcast

PowerPoint format lends itself almost perfectly to lecture capture, that is, the recording of slides in synch with the lecturer's voice. (This is very different than a video camera on a tripod recording the speaker from the back of the room.) Many educational YouTube videos use this format, notably those from Khan Academy. Larger universities, such as Penn State, record all lectures this way. Others, including Pacific University, have made the use of software like Camtasia Relay optional, at the instructor's discretion. Lectures captured in this format are easily used as podcasts.

Concerns have been raised that podcasting will adversely affect class attendance, though I personally have not noticed an effect if classes are kept rigorous and engaging. Lecturers who do not allow podcasting for one reason or another should be aware that students are capable of making their own podcasts using the instructor's PowerPoint,

“Many seasoned presenters have overcome the initial thrill of animations and fancy transitions in their lectures, the overuse of which has been called “PowerPointlessness.”

an audio recording of the lecture, and Microsoft OneNote, which is now available for both Windows PC and Macintosh platforms. This software has the major advantage of being searchable. One way or another, video podcasts are being used. The question of whether they are as effective as face-to-face lectures for healthcare education remains.

There is at least one study that attempted to answer this question. In a randomized crossover trial at the Imperial College School of Medicine in London, Schreiber, Fukuda and Gordon studied 100 undergraduate medical students to see which format was more effective, live PowerPoint lecture or video podcast.³ The students were randomized to one of the two formats. The live lecture used the same PowerPoint slides recorded by the same instructor using the same script as a Soundstudio

video podcast (which only showed the slides with synched audio narration). The podcasts were on medical topics (arthritis and vasculitis) and available at www.podmedics.com. The groups were crossed over for a second lecture in the other format. A multiple-choice exam and qualitative survey were given to compare the formats.

Sixty-six participants, 33 in each group, completed the study. The results showed that multiple-choice exam results were the same regardless of presentation method. Students found the face-to-face lecture format more engaging, but enjoyed the convenience of the podcast because they could watch it when they were ready to learn, and at their own speed (including stopping and reviewing at will). The authors concluded that as of 2010, “video podcasts are not ready to replace traditional teaching methods.”

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(Sponsored by International Vision Expo)



Tough Talks and Patient Privacy

By Ryan Anderson

Decisions are made every day in regard to patient care in optometry. Most are easy, but some require a bit more deliberation involving ethical considerations and ultimately the patient's best interest. During my rotation at Midwestern University Eye Institute, I encountered a patient who was a relative of another optometry student in my program. The patient was a 26-year-old healthy, white male with no significant ocular history other than LASIK surgery years prior; he reported compliance with yearly routine eye examinations. He presented with the complaint of acute onset scotoma in the left eye status post a "cold" two weeks prior. His systemic health was unremarkable. He was able to locate his blind spot and felt this was a new area of vision loss. Upon examination, he was 20/20 in each eye distance and near. Preliminary testing was normal; there was no afferent pupillary defect. Refraction was deferred. Anterior segment examination revealed no abnormal findings, but the patient did note that the slit lamp light was partially missing when I held it just temporal to his visual axis. After dilating, I found a single cotton wool spot (CWS) temporal to his macula (about equidistant between the fovea and optic nerve in the left eye). It was approximately 0.5 mm in size with distinct margins and round. Additional testing to further investigate this spot, including macular OCT, central visual field, fundus photo, Amsler grid and Watzke-Allen tests, was completed. All tests indicated a definite and well-defined area

of visual field loss temporal to his visual axis consistent with his chief complaint. Fundus photos and OCT documented the CWS, which was correspondent in location with the area of field loss. The spot was affecting the sensory retina all the way into the deeper layers, which was slightly different in the appearance of a typical CWS. My preceptor and I advised him to pursue serology to evaluate for a systemic etiology. A complete blood cell count with differential for gross hematologic abnormality or cancer, fasting blood glucose for diabetes, and a complete metabolic panel for other systemic problems was obtained. We did not expect any of these tests to come back positive for any disease but it was our responsibility to at least rule out potential systemic causes. There are other causes worth ruling out including HIV/AIDS or sexually transmitted diseases. These diseases can also be transmitted via intravenous drug use. However, our patient was of Mormon faith and known to not associate with these activities. It was still a conversation we, as health professionals, were obligated to have regarding whether he had engaged in any of these activities to warrant testing for these diseases. He denied participation so we educated him on the importance of ruling out those diseases should there be any possibility he could have contracted them, but we were comfortable not including them in our battery of initial tests.

We had a discussion with the patient pertaining to how far we wanted to take the testing. Since it presented as a

single isolated spot, it was likely to be a rare complication of the recent viral infection from a common cold that had since resolved. If that was the case, further testing would come back negative. We also considered the financial burden to the patient as these tests are costly. On the other hand, if this patient was really concerned about narrowing it down at the very least, it wouldn't be unnecessary to test for as many potential causes as the lab had to offer. The patient expressed understanding and left the clinic to obtain the testing immediately. He was scheduled to return in six weeks, which is the approximate amount of time it should take for a CWS to disappear completely helping to confirm our diagnosis.

After he left the clinic, I was contacted by his relative in my optometry class who was understandably eager to see the photos and OCT images. I had not thought to have our patient sign a release before he left so I may divulge all the information we had acquired in the exam. I was at a dilemma of simply talking to him about the exam since I am good friends with him. I knew my patient wouldn't mind and might even prefer we discussed it with his relative; however, I decided it was best to have the patient return to sign a release for his records before I discussed any exam information. It was definitely an inconvenience, but I decided no matter how much you think you know about a situation, it only takes one misreading of someone's personality to violate HIPAA laws and seriously harm your career be-

cause of it. All in all, I feel it was the right decision and both the patient and his relative understood.

At his follow-up appointment, my patient still had the loss of vision, but his CWS was gone. All of his lab testing was negative, and we ultimately left it up to him to decide on further testing. We discussed with him our thoughts on the situation regarding his lifestyle and explained his problem was likely due to a rare opportunistic infectious process

as he was sick two weeks prior to noticing the blind spot. We reinforced that if he wanted to pursue further testing, we would be happy to order the tests and direct him where to go. After everything, he decided he was fine without the additional testing and just monitoring it. It was an interesting case that brought up some tough conversations, but, all in all, patient safety and patient information laws were accurately followed.

Ryan Anderson graduated from the Midwestern University Arizona College of Optometry this spring. He had served as the Vice President of the Vision Development Club, Treasurer of Beta Sigma Kappa International Optometric Honor Society, and Activities Coordinator for the Class of 2014 Student Government. After graduation Ryan planned to complete a post-doctoral residency in Primary Eye Care with the Veterans Affairs San Diego Health Care System in California.

SPECIAL ANNOUNCEMENT

Four Research Projects Receive ASCO Starter Grants for Educational Research



The Association of Schools and Colleges of Optometry (ASCO) and The Vision Care Institute, LLC, an affiliate of Johnson & Johnson Vision Care, Inc., are pleased to announce the recipients of the 2014 Starter Grants for Educational Research. Grants were awarded to:

- Impact of Computerized Classroom Test Administration on Student Performance / Gregory Fecho, OD, Jamie Althoff, OD, and Patrick Hardigan, PhD (Nova Southeastern University)
- The Effect on Knowledge and Attitude of an Interprofessional Education Curriculum to Optometry and Physician Assistant Students / Ray Chu, OD, MS (Southern California College of Optometry at Marshall B. Ketchum University)
- Enhanced Clinical Readiness for Optometry Students Entering Second Year / Fuensanta Vera-Diaz, OD, PhD, and Catherine Johnson, OD (New England College of Optometry)
- Acupuncture and CAM Services in Optometric Education / Mort Soroka, PhD, MPA (State University of New York, State College of Optometry)

Congratulations to this year's grant recipients! ASCO and *Optometric Education* look forward to the completion and publication of the projects.

Traumatic Hyphema: A Teaching Case Report

Priscilla Lenihan, OD

Dorothy Hitchmoth, OD, FAAO

Abstract

Hyphema is the presence of blood in the anterior chamber of the eye and is most often caused by blunt ocular injury. Hyphema, its complications and associated ocular injuries can pose a serious threat to vision and therefore require appropriate medical management and careful examination and follow-up. This teaching case report reviews the management of traumatic hyphema and discusses treatment options, potential complications and visual prognosis.

Key Words: traumatic hyphema, closed-globe injury, glaucoma medications, traumatic glaucoma

Introduction

The following case report is to be used as a teaching guide appropriate for third- and fourth-year optometry students as well as optometry residents. The case report describes a patient with hyphema as a result of closed-globe injury who develops a number of associated sequelae of blunt force trauma to include increased intraocular pressure, vitreous hemorrhage and angle recession with iridodialysis. The paper discusses appropriate management and treatment options as well as short- and long-term complications of traumatic hyphema. This case demonstrates the importance of identifying clinical findings related to poor visual outcome and how to manage them appropriately.

Learning Objectives

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

1. Discuss signs and symptoms of initial presentation of traumatic hyphema
2. Discuss appropriate treatment for the initial presentation of traumatic hyphema
3. Recognize short- and long-term complications associated with traumatic hyphema
4. Recognize initial and long-term clinical findings related to poor visual outcome as a result of traumatic hyphema
5. Discuss appropriate treatment options for management of increased intraocular pressure (IOP) or glaucoma that results from hyphema or associated complications
6. Provide proper patient education on self-care needed to avoid complications.

Key Concepts

1. Pathophysiology and natural history of traumatic hyphema and its complications
2. Risk factors associated with poor visual prognosis
3. The role of medication in reducing the risk of developing complications

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4. Medications, activities and diagnostic testing to avoid in the patient with traumatic hyphema.

Discussion Points

1. Anatomical considerations of closed-globe injury
 - a. Cornea
 - b. Anterior chamber and angle
 - c. Iris and ciliary body
 - d. Vitreous and posterior pole
2. Treatment considerations (initial and subsequent)
 - a. Worsening of the condition
 - b. Development of complications
 - c. Improvement of the condition
 - d. Contraindications and side effects of medication
3. Clinical examination
 - a. Slit lamp and fundus examination
 - b. Ocular ultrasound
 - c. Gonioscopy
 - d. Imaging of the globe, orbit and adnexal structures
4. Visual prognosis
 - a. Complications and associated injuries
 - b. Risk factors
 - c. Medical and surgical intervention.

significant for diabetes mellitus type 2, hypertension, mixed hyperlipidemia, obstructive sleep apnea, insomnia, osteoarthritis, post-traumatic stress disorder and adjustment disorder with mixed anxiety. His list of medications included aspirin, ibuprofen, bupropion, tramadol, sertraline, glyburide, metformin, lisinopril, metoprolol, simvastatin, nifedipine and prazosin.

Entering visual acuities without correction were 20/20 OD and 20/150 OS. The right pupil was round and responsive to light and measured 2.5 mm. The left pupil was fixed, mid-dilated, and measured 4.0 mm. Extraocular muscles (EOMS) were smooth, accurate, full and extensive (SAFE) OU. There was no irregularity of the left orbital bone or sinus crepitus on palpation of the orbit and adnexal structures. Slit lamp exam revealed clear lids and lashes OD and mild edema and hematoma of the upper and lower left lids without lacerations. The sclera and conjunctiva were clear of defect or hemorrhage OD. The left eye showed a subconjunctival hemorrhage involving the entire bulbar conjunctiva. The

corneas were clear of defect with fluorescein staining and there was negative Seidel sign. Anterior chamber angles were open to grade III Van Herick OU. The anterior chamber of the right eye was well-formed, clear and quiet. The left anterior chamber was well-formed but 2+ red blood cells and a hyphema that measured a vertical height of 2.2 mm were noted (**Figure 1**). The right iris was normal and without rubeosis; the left iris was dyscoric (irregularly shaped) and free of rubeosis. Goldmann tonometry revealed pressures of 14 mmHg OD and 18 mmHg OS. The patient was dilated with two drops of 1.0% tropicamide and two drops of 2.5% phenylephrine OS. No clear view of the left fundus was observed with either binocular indirect ophthalmoscopy (BIO) or 90D lens due to the debris in the anterior chamber. A B-scan ultrasonography was performed OS, which revealed no retinal detachment, vitreous hemorrhage or subluxated lens.

The patient was diagnosed with traumatic hyphema OS and was prescribed prednisolone acetate 1% ophthalmic solution QID OS and

Case Description

Patient RM, a 60-year-old Caucasian male, presented to the eye clinic at the White River Junction Veterans Affairs Medical Center on Aug. 21, 2012, complaining of severe pain, blurred vision and sensitivity to light in the left eye. The patient reported someone threw a rock at him that hit his left eye the previous evening around 7 p.m. The patient had glasses, but was not wearing them at the time of the injury. RM denied flashes and floaters.

RM was an established patient at the eye clinic. His ocular history included a branch retinal vein occlusion in the right eye diagnosed in 2010, early bilateral cataracts and mild non-proliferative diabetic retinopathy without clinically significant macular edema OU. His medical history was

Figure 1
Patient RM seen with a hematoma of the upper and lower lids, dense subconjunctival hemorrhage and grade 1 hyphema of the left eye.



atropine sulphate 1% ophthalmic solution BID OS. RM was released from the clinic and given instructions for self-care at home. He was educated to shake the bottle of topical steroid before instillation. He was also given a non-pressure eye patch to reduce photophobia when outdoors or in bright light only. In addition, the patient was given a pair of clear protective goggles to be worn during sleep. He was instructed to sleep at an angle of approximately 45 degrees, to rest as much as possible, and to avoid any strenuous activity. A follow-up appointment was scheduled for 24 hours, and the patient was instructed to return to clinic sooner if he developed visual changes or increased pain.

The following day, RM reported the pain in the left eye had improved. He was using his drops as instructed and had worn the protective goggles at night. RM denied flashes but noted that vision in the left eye fluctuated. Visual acuity was measured at 20/80-2 OS; EOMS were SAFE OU. There was no pain or crepitus on palpation of the left orbit and adnexa. Anterior segment exam was the same with the exception of the hyphema which was measured at 2.1 mm. IOPs were measured to be 14 mmHg OD and 26 mmHg OS. The lens was well-positioned with mild nuclear sclerotic cataracts in both eyes. BIO of the posterior segment OS revealed diffuse vitreous hemorrhage with coagulation noted to be greatest in the inferior view. The optic nerve had a cup/disc ratio of 0.20 with healthy and distinct rims. The macula was clear and the periphery was flat and intact 360 degrees. RM was instructed to continue with atropine sulphate 1% ophthalmic solution BID OS and prednisolone acetate 1% ophthalmic solution QID OS. Timolol 0.5% ophthalmic solution BID OS was added to treat the ocular hypertension. The patient was instructed to discontinue oral aspirin after consultation with his primary care physician. The patient was instructed to return to clinic again the following day.

The next day, in the left eye, vision measured 20/50-, the hyphema was measured to be 2.0 mm, and intraocular pressure was measured at 25 mmHg. All other findings were

stable. An orbital X-ray was ordered and was negative for orbital or other facial bone fractures. Medication and instructions remained the same with the exception that timolol 0.5% ophthalmic solution was replaced with dorzolamide 2%/timolol 0.5% (Cosopt) BID OS. The patient was instructed to return to clinic in two days and to continue all other self-care instructions.

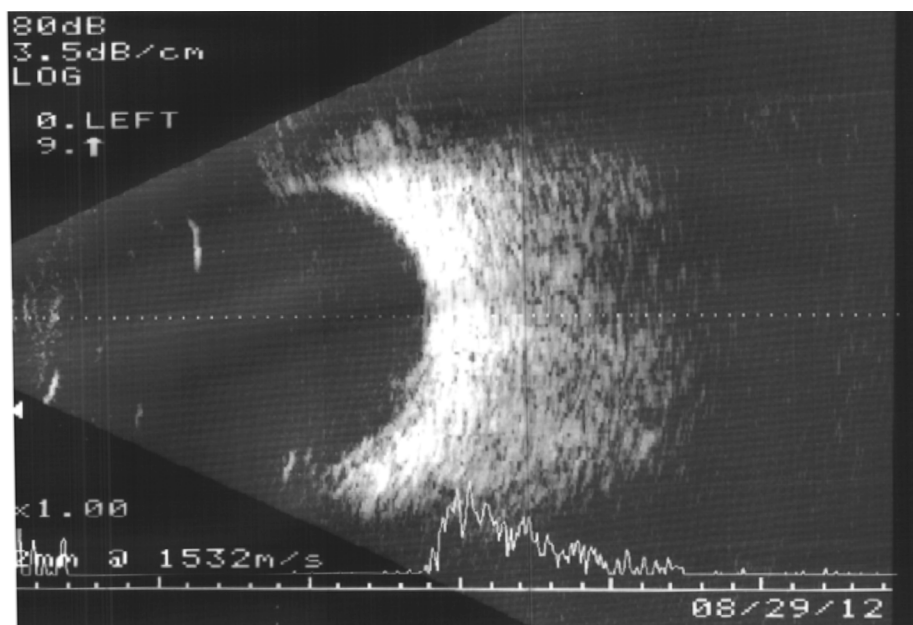
Summary of Visits and Clinical Outcomes

The traumatic hyphema slowly resolved after nine days. The anterior segment, level of hyphema and IOP were monitored at each visit. Retinal examinations through direct funduscopy and B-scan (**Figure 2**) continued throughout the course of follow-up as well to monitor for cystoid macular edema and to ensure the vitreous hemorrhage was resolving without additional complications such as retinal tear, retinal detachment or vitreoretinal traction. A complication encountered during resolution of the hyphema was a rise in IOP. One week after the initial trauma, intraocular pressure increased to 34 mmHg OS despite the use of Cosopt

TID. Acetazolamide 500 mg PO BID was added to the patient's medication regimen, which otherwise remained the same. Patient medical history, including allergies and kidney function, was carefully reviewed prior to initiating oral acetazolamide. The patient was also educated on the side effects of acetazolamide to include increased urination, metallic taste and tingling in the extremities. IOP remained elevated at 36 mmHg OS the following day. Pachymetry revealed thick and asymmetric corneas (607 μ m OD, 662 μ m OS); thickness was significantly greater in the left eye due to corneal edema that had developed. The patient's medication was kept the same, and the following day his IOP dropped to 21 mmHg OS. Over the next several visits, vision continued to improve, anterior segment inflammation and corneal edema slowly resolved, and intraocular pressure dropped and stabilized. Prednisolone acetate 1%, Cosopt and acetazolamide were correspondingly tapered and discontinued. See **Appendix A** for a detailed account of the patient's pertinent exam findings. Final best corrected visual acuity was 20/20- in the left eye.

Gonioscopy was performed 12 weeks

Figure 2
B-scan of the left eye taken nine days after the initial trauma showing a mild, diffuse vitreous hemorrhage seen as short lines and faint dots within the vitreous cavity.



after the initial trauma with a three-mirror lens. The right eye was open to ciliary body in all quadrants with 2+ pigmentation of the trabeculum. The left eye was open to ciliary body temporally and nasally. The inferior angle was open to scleral spur with 4+ pigmentation and pigment clumping on the iris (Figure 3). The superior angle revealed four clock hours of angle recession with iridodialysis (Figure 4).

Literature Review

Hyphema is defined as a collection of blood in the anterior chamber. The severity of hyphema can vary from diffuse red blood cells circulating in the aqueous humor to a hemorrhage that fills the entire anterior chamber. Most often hyphema is caused by trauma or intraocular surgery, but may also occur spontaneously in patients with rubeosis iridis, vascular tufts at the pupillary margin, juvenile xanthogranuloma, iris melanoma, myotonic dystrophy, keratouveitis, leukemia, hemophilia, thrombocytopenia or Von Willebrand disease. Hyphema may also be associated with drugs that alter platelet or thrombin function, such as aspirin or warfarin.¹

Hyphemas are graded according to examination features as noted in Table 1. The grading system is helpful for predicting clinical outcomes, which assists in educating the patient about short- and long-term prognosis.

Epidemiology

The mean annual incidence of hyphema from all causes is approximately 17 per 100,000.¹ The majority of hyphemas occur in males (75%-78%) with a median age of 15.5 to 18.2 years.² A study of 238 patients with traumatic hyphema showed that the leading cause of trauma was projectile stones, and the majority of the trauma occurred as a result of street violence (43%) and accidents in the home (33%). In children, siblings and friends were responsible for most of the trauma, and in adults the main cause of trauma was accidents.³ Another significant source of injury is sports, which accounted for 60% of traumatic hyphemas in a different study.⁴ High-risk sports in which the ball hits the eye include baseball, softball, basketball, soccer and paint-

Figure 3
Gonioscopic view of the inferior angle of the left eye showing heavy pigmentation and clumps of pigment on the iris and angle structures.

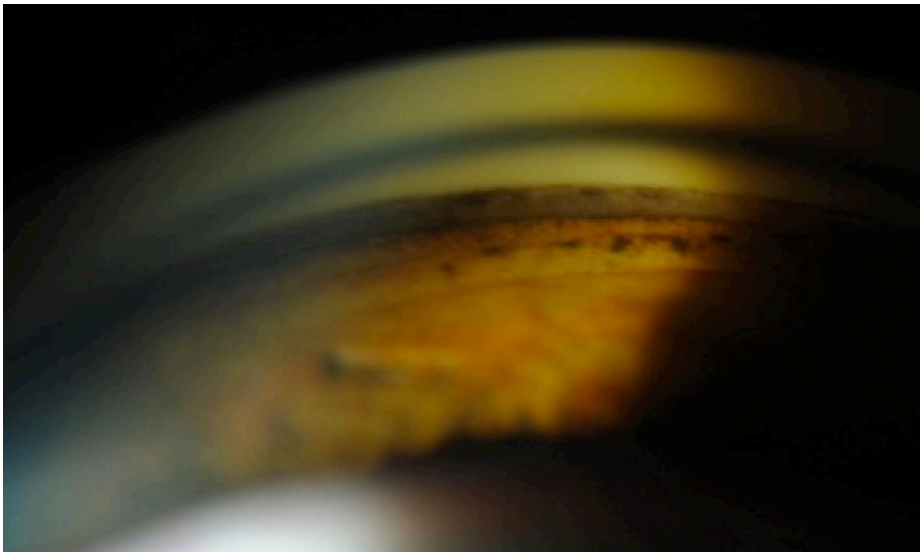


Figure 4
Gonioscopic view of the superior angle of the left eye showing iridodialysis. Ciliary processes (black arrows) are visible in the cleft between the iris and cornea.

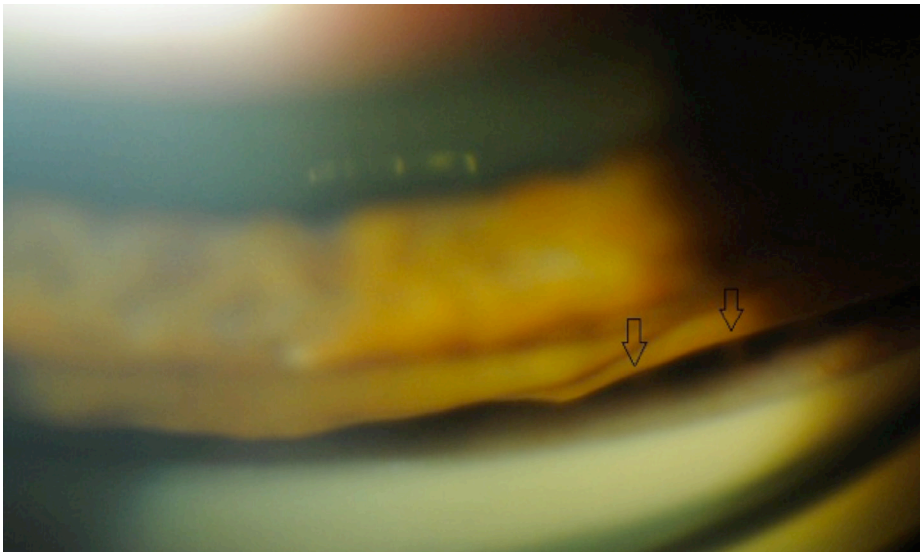


Table 1
Hyphema Grading

Microhyphema	Red blood cells suspended in the AC without the formation of a layered clot
Grade 1	Layered blood occupying less than one-third of the AC
Grade 2	Layered blood filling one-third to one-half of the AC
Grade 3	Layered blood filling one-half to less than the total volume of the AC
Grade 4	Blood filling the entire volume of the AC
“Eight-ball”	Total hyphema of blackish-purplish color

AC = anterior chamber.

ball. The stick or racquet is more likely to be the source of injury in other high-risk sports such as hockey, racquetball and squash.⁵

Pathophysiology

Hyphema that occurs as a result of trauma is typically caused by damage to the major arterial circle and its branches as a result of a tear in the iris or ciliary body.⁶ Blunt trauma causes antero-posterior compression of the globe and simultaneous equatorial expansion. This expansion creates stress on the structures of the anterior chamber angle, causing a tear of the ciliary body or iris stromal vessels.¹

Patients with hyphema may initially present with low or high IOP. A low IOP may be the result of an accompanying iritis causing reduction in aqueous production or due to temporary increase in outflow from the disruption of structures in the anterior chamber angle.⁶ More commonly, IOP rises acutely because red blood cells and immune-inflammatory cells block the trabecular meshwork.⁷ Fresh red blood cells are able to pass through the trabecular meshwork without much difficulty; however, the presence of an overwhelming number of cells in addition to plasma, fibrin and other cellular debris can lead to a transient obstruction of outflow.⁶ Swelling of the trabecular meshwork (trabeculitis) may also be a contributing factor in limiting outflow.⁸ In severe cases, acute elevation of IOP may occur secondary to pupillary block, due to a collar button-shaped clot involving both the anterior and posterior chambers.¹ The clot prevents the normal flow of aqueous from the posterior chamber, through the space between the iris and lens, and into the anterior chamber. As a result, pressure builds in the posterior chamber, pushing the peripheral iris anteriorly which then closes part or all of the trabecular meshwork via apposition.

Aqueous outflow may be further obstructed in patients with sickle cell hemoglobinopathies. Erythrocytes in these patients become elongated and rigid (sickled) in the aqueous humor, making passage through the trabecular meshwork difficult.⁶ As a result of an increase in IOP, the anterior and posterior segments of the eye become in-

creasingly hypoperfused and hypoxic, thereby perpetuating a cycle in which further sickling and sludging of erythrocytes occurs.⁹ Therefore, the incidence of elevated IOP in the presence of hyphema is higher in patients with these disorders, and may occur even in cases of small hyphemas.⁶

Associated Trauma

The pattern of injury from blunt trauma is due to the equatorial expansion of the globe. These injuries have been described as seven rings and include: radial tears of the pupillary sphincter, iridodialysis, angle recession, cyclodialysis, trabecular meshwork tear, zonular dehiscence and retinal dialysis. The presence of these clinical findings, even years after the event, provides evidence of previous blunt trauma.⁸ Blunt ocular trauma may also cause iridoschisis (separation of the layers of the iris stroma) iritis, cataracts or chorioretinal injury.⁶

Treatment and Management

Management of hyphema from all causes is aimed at preventing secondary hemorrhage, preventing further trauma to the eye, promoting the settling of blood to the bottom of the anterior chamber and controlling traumatic uveitis.⁴ Close monitoring is essential so that treatment for associated complications is initiated promptly if they occur.

Hospitalization or outpatient care with daily follow-up is recommended. Hospitalization should be considered for patients with severe injuries or blood disorders and those who are not capable of self-care or may be non-compliant with the treatment regimen. Additionally, hospitalization should be considered for children at risk for amblyopia or if child abuse is suspected. Management consists of eye protection with plastic or metal shields, limited physical activity, elevation of head posture, and avoidance of aspirin and other non-steroidal anti-inflammatory agents.¹⁰ Having patients sleep at a 30-45-degree angle promotes more rapid blood resorption and lowers venous pressure to the globe, helping to reduce IOP and to allow for clot formation and resolution.⁷ Normal activities may resume one week after the initial injury or rebleed. However, if blood remains in the anterior chamber after one week,

activities should remain restricted until blood resorption occurs.¹⁰

Iritis is common in patients presenting with traumatic hyphema. Corticosteroids are prescribed to reduce the inflammation and cycloplegic drugs are used to improve patient comfort and prevent the formation of posterior synechia.¹ Cycloplegics are anticholinergic drugs. They temporarily inhibit acetylcholine receptors in the iris sphincter muscle and ciliary body. This results in pupillary mydriasis, which helps reduce the risk of posterior synechia by minimizing contact between the posterior iris and the anterior lens capsule. Inhibition of acetylcholine receptors in the ciliary body paralyzes the muscle, which relaxes ciliary spasm and reduces pain.¹¹ In addition, both cycloplegics and corticosteroids may reduce the risk of secondary hemorrhage. Steroids stabilize the blood-ocular barrier and directly inhibit fibrinolysis.¹ Cycloplegics minimize iris movement and stress on the original ruptured vessels.¹²

In patients with elevated IOP higher than 25 mmHg, beta blockers and carbonic anhydrase inhibitors (CAIs) are usually first-line treatment.⁸ Topical CAIs must be used cautiously in patients with sickle cell hemoglobinopathies because these medications may lower the aqueous pH and promote further sickling of the blood cells.¹⁰ If topical medication is not adequate in managing IOP, an oral CAI, such as acetazolamide and methazolamide, can be prescribed. The ocular hypotensive effect of acetazolamide in tablet form peaks in two hours and lasts for six hours, whereas in capsule form it peaks in eight hours and persists beyond 12 hours. Acetazolamide is generally dosed as 500 mg PO twice a day for adults. For children, the recommended dose is 5-10 mg/kg of body weight every four to six hours. Methazolamide dosing can begin with 25 mg twice a day and be increased to 50 mg twice a day or up to 100 mg three times a day if needed. Oral CAIs are effective in lowering IOP; however, they have many side effects. Common systemic side effects include increased urinary frequency and paresthesia of the fingers, toes and around the mouth. Other side effects include abdominal discomfort, metallic taste, nausea and diarrhea. Higher

doses of oral CAIs may cause metabolic acidosis and should be avoided in patients with hepatic insufficiency, renal failure, adrenocortical insufficiency, hyperchloremic acidosis, depressed sodium or potassium levels or severe pulmonary obstruction. Oral CAIs are contraindicated in patients with sulfa allergies, as CAIs belong to the sulfonamide class of drugs.⁶ If a systemic CAI is necessary in patients with sickle cell, methazolamide is used because it creates less systemic acidosis, and therefore promotes less erythrocyte sickling, than acetazolamide.¹ Intravenous mannitol, a diuretic, may also be given in cases of uncontrolled IOP; however, extreme caution must be used in patients with sickle cell, as diuretics induce acidosis and volume contraction.⁵

Prostaglandins and pilocarpine are generally avoided in the treatment of elevated IOP because of inflammation associated with the traumatic hyphema. Some early studies showed that large doses of topical prostaglandins resulted in inflammation and breakdown of the blood-aqueous barrier. In more recent reports, a few patients developed anterior uveitis while on latanoprost. Other studies, however, have not shown intraocular inflammatory effects from prostaglandins.⁶ An increase in blood-aqueous barrier permeability to plasma proteins has been shown clinically after instillation of pilocarpine.¹³ Additionally, miosis induced by pilocarpine increases the zone of contact between the iris and lens, and therefore increases the risk of posterior synechia.

Surgical intervention is required in up to 5% of hyphemas in cases of increased IOP, corneal blood staining, or total hyphemas lasting more than 10 days. If the IOP remains greater than 50 mmHg for five days, or greater than 35 mmHg for seven days, despite medical management, surgery is indicated.¹² Anterior chamber paracentesis is effective for lowering IOP; however it is often only a temporary measure and additional surgical intervention is anticipated.¹⁰ Irrigation of the anterior chamber can be performed to remove dispersed red blood cells, and a formed blood clot can be manually extracted through clear corneal incisions.¹ If necessary, trabeculectomy is performed to manage IOP by creating a new opening

for aqueous outflow. Verma¹⁴ reported that the combination of trabeculectomy, peripheral iridectomy and manual extraction of blood clots was satisfactory in lowering IOP. All patients in the study had light projection acuity, corneal blood staining and an average IOP of 45 mmHg before surgery. Average IOP at the last follow-up visit after surgery was 18.4 mmHg, but visual prognosis was still poor. Laser trabeculoplasty is usually ineffective in cases of ocular trauma, due to the damage to the trabecular meshwork.⁸

Additional medications may be used in the treatment of hyphema as blood in the anterior chamber begins to form a clot. Blood clots are cleared from the body through a process known as fibrinolysis. It is during this process that the risk of rebleed is the highest.¹² Antifibrinolytic agents, including ϵ -aminocaproic acid (ACA) and tranexamic acid, are used to reduce the risk of secondary hemorrhage by slowing or inhibiting the resorption of the blood clot within the traumatized blood vessel. ACA acts as a competitive inhibitor to lysine for binding sites on tissue plasminogen activator, thereby inhibiting the conversion of plasminogen to plasmin. Plasmin is the enzyme involved in the breakdown of the fibrin clot. In addition to preventing the formation of plasmin, ACA also competitively inhibits the binding of plasmin to the fibrin clot itself.⁴ These actions stabilize the fibrin clot, thereby preventing rebleeding while permanent vessel repair occurs.¹ Side effects of systemic ACA occur in up to 50% of patients and include nausea, vomiting, systemic hypotension, tinnitus (less commonly), numbness, skin rash, myalgia and hematuria.¹⁵ It is contraindicated in patients with coagulopathies, renal disease, and in patients who are pregnant, and should be used cautiously in patients with hepatic, cardiovascular or cerebrovascular diseases. ACA in a topical gel form has comparable effectiveness as the oral form, but with few side effects.⁴ Karkhanavich et al¹⁶ found topical ACA did not affect the rate of rebleeding, but was associated with a longer time for clot absorption in the anterior chamber. Tranexamic acid, another antifibrinolytic agent, has a similar mechanism of action as ACA. Tranexamic

acid also has similar side effects, but less gastric side effects. Although data suggest that antifibrinolytic agents reduce the risk of secondary hemorrhage, they do not have a significant effect on visual acuity, and their use is controversial.⁴ Therefore, several authors recommend reserving antifibrinolytics only for those patients at higher risk for secondary hemorrhage based on individual patient characteristics, including race and the presence of sickle cell hemoglobinopathy.^{9,4}

Complications

Elevated IOP

Elevated IOP is the most serious complication of traumatic hyphema as it may result in optic atrophy and corneal blood staining.¹⁷ Elevated IOP occurs in approximately one-third of all hyphema patients. In general, the larger the hyphema, the higher the risk of developing increased IOP.¹ In a study of 162 patients with microhyphema, IOP was elevated (above 22 mmHg) in only 8.6%, and in those patients with elevated IOP there was a significantly higher incidence of angle recession.¹⁸ Patients with sickle cell hemoglobinopathies require aggressive IOP lowering measures, as these patients are at higher risk for central retinal artery occlusion and optic nerve damage, even with only marginal increases in IOP.⁹

Recurrent hemorrhage

Recurrent, or secondary, hemorrhage occurs if the size of the hyphema increases, if fresh blood is seen over the older and darker clot, or if dispersed red blood cells appear over the clot after the initial blood has settled.¹ Lysis and contraction of the fibrin plug in the injured vessels is responsible for the rebleed, which usually occurs two to five days after the initial injury.¹⁶ Recurrent hemorrhage is associated with complications including elevated IOP, corneal blood staining, optic atrophy and peripheral anterior synechia.¹ While these complications can result in permanent loss of vision, some studies have shown that secondary hemorrhage is associated with a worsening of visual prognosis,^{3,17} while others have not.^{19,20}

The highest prevalence of hyphema rebleed in the United States is in the non-white population. Patients with an initial higher grade hyphema (grade 3-4)

are also at higher risk.¹⁵ In a study of 40 children with traumatic hyphema, the overall rate of secondary hemorrhage was 10.3% and was significantly higher in African American patients.⁹ Rahmani et al³ found a greater chance of rebleeding in patients with poor vision or elevated IOP at the time of presentation. Aspirin has been shown to increase the risk of rebleeding. Therefore, it, along with other non-steroidal anti-inflammatory drugs, should be avoided for two weeks after traumatic hyphema due to their antithrombotic effect.¹⁸ Acetaminophen or codeine, however, are safe to use as an analgesic if not otherwise contraindicated for other medical reasons.¹⁰

The incidence of rebleed in patients with microhyphema is lower. Recchia et al¹⁸ found that only three out of 162 patients (1.9%) with microhyphema developed rebleed, and all three occurred on post trauma day three. ϵ -aminocaproic acid is not used in patients with traumatic microhyphema because the risk of significant rebleeding is much lower in these patients, and the benefits of ϵ -aminocaproic acid do not outweigh the risks of the medication.¹⁸

Corneal blood staining

Corneal blood staining occurs when hemoglobin and hemosiderin enter the corneal stroma.⁷ Corneal blood staining is more common with larger hyphemas, rebleeding, prolonged clot duration, sustained elevated IOP and corneal endothelial cell dysfunction. Slit lamp examination reveals straw yellow discoloration of the deep stroma greater centrally than peripherally in the early stages.¹ Corneal blood staining remains for years and does not respond to medical treatment. In young children, staining may cause amblyopia. For these reasons, surgical intervention is required when the presence of microscopic blood staining is noted.²¹

Ghost cell glaucoma

Ghost cells are degenerated erythrocytes that form within the vitreous cavity over the course of several weeks after a vitreous hemorrhage. If the anterior hyaloid face is ruptured by trauma, surgery or spontaneously, the ghost cells can freely move into the anterior chamber. These rigid, khaki-colored

ghost cells are less pliable than fresh erythrocytes and cause approximately three times the obstruction to trabecular outflow than an equal number of fresh erythrocytes. Ghost cell glaucoma can also occur with large traumatic hyphemas that extend into the vitreous cavity. The ghost cells that form in the vitreous cavity migrate back into the anterior chamber weeks to months after the initial injury, creating another spike in IOP.²² Slit lamp examination will reveal khaki-colored cells freely floating in the anterior chamber, or a tan stripe in a background of red cells, creating the candy-stripe sign.⁸ Medical therapy is frequently sufficient to manage IOP until the supply of ghost cells is exhausted, but surgery may be necessary.²²

Traumatic glaucoma

The most common site of damage in blunt ocular trauma is the anterior segment. The most common of these injuries is angle recession, which is a tear between the longitudinal and circular muscles of the ciliary body.⁶ More than 50% of patients with traumatic hyphema will have some degree of angle recession. Greater amounts of angle recession, typically 180 degrees or more, are associated with higher risk for developing glaucoma.⁸ Angle recession itself is not the cause of chronically elevated IOP, but rather it provides evidence of previous trauma and represents permanent damage to the trabecular meshwork. Another mechanism of chronically elevated IOP is the extension of an endothelial layer from the cornea over the structures in the anterior chamber angle.⁶ The presence of heavy trabecular pigmentation, elevated baseline IOP, hyphema, angle recession and lens displacement with a cataract are significant predictors of chronic traumatic glaucoma.²³ In patients with angle recession, 5-20% will develop glaucoma in the injured eye, and of those who do develop glaucoma, up to 50% will develop glaucoma in the fellow uninjured eye, which suggests these patients may have a predisposition to this condition.⁸

Discussion

A patient with traumatic hyphema may present with variable symptoms of blurred vision, pain and photophobia. Vision typically follows the severity

of the hyphema itself. Vision may be entirely normal to no light perception with hyphema ranging from microhyphema to "eight ball" hyphema. The degree of pain and photophobia is related to the severity of associated uveitis and the level of IOP.⁷

A ruptured globe must be ruled out at the initial examination. The cornea should be carefully evaluated for positive Seidel sign to rule out full-thickness laceration. Other signs of ruptured globe include a deep or shallow anterior chamber compared to the fellow eye, peaked or irregular pupil, iris transillumination defects, and low IOP. Additionally, orbital fracture must be ruled out. Signs and symptoms of orbital fracture include pain and restriction on eye movement, local tenderness, binocular diplopia, crepitus after nose-blowing or on palpation, and hypoesthesia along the ipsilateral upper lip, cheek and forehead. Orbital imaging (X-ray or CT scan) should be ordered if an orbital fracture is suspected.¹⁰

Patients must be seen daily during the first five to seven days post-hyphema. This exam frequency is critical because recurrent hemorrhage almost always occurs before the seventh day. Visual acuity, slit lamp exam with careful monitoring of corneal clarity and size of hyphema, tonometry, and assessment of patient compliance with medication and self-care are required.⁷ The vertical height of the hyphema should be measured at the initial examination because an increase in size at a subsequent visit is an indication that a recurrent hemorrhage has occurred. A careful evaluation of the anterior chamber is needed to identify the presence of, and to distinguish between, white blood cells, red blood cells and ghost cells. The clarity of the cornea must be closely monitored to assess for corneal blood staining.

Dilated fundus exam, without scleral indentation, is necessary to assess the posterior segment for complications secondary to the initial trauma. Posterior segment injuries are significant predictors of poor visual outcome; however, the detection of these findings can be challenging during initial examination due to poor visualization through the hyphema and/or vitreous hemorrhage. Ultrasound can be helpful in evaluating

the posterior segment if it cannot be examined initially. Care must be taken to avoid too much pressure on the globe due to the risk for rebleed. Virtually no pressure needs to be applied over closed lids to obtain useful echograms. On B-scan, a fresh, mild hemorrhage shows dots and short lines in the vitreous cavity. Denser hemorrhages show higher reflectivity and a greater number of opacities. The vitreous hemorrhage may also organize into layers in the lower periphery of the globe, forming highly reflective pseudomembranes. B-scan of a retinal tear will show a small, focal, echo-dense membrane of the posterior surface attaching to the posterior hyaloid. A retinal detachment appears as a bright, continuous, somewhat folded membrane that may insert at the ora serrata, optic disc or elsewhere in the fundus. Ultrasound may also be used to assess the anterior segment in cases of corneal opacification or large hyphema.²⁴ High frequency ultrasound biomicroscopy provides high resolution images and can be useful in detecting areas of angle recession, cyclodialysis or weak zonules.⁶

Gonioscopy is performed three to six weeks after the injury to assess for angle recession. Gonioscopy should not be performed before this time because the procedure may increase the risk of rebleed.⁸ Signs of angle recession include a posteriorly recessed iris revealing an irregular widening of the ciliary body band, an uneven iris insertion, and an area of torn or absent iris processes.¹⁰ In addition, the presence of pigment balls or clumps on the trabecular meshwork may be seen, which is highly associated with previous traumatic hyphema.⁶

Traumatic hyphema is usually a self-limiting condition that typically has good visual prognosis. Approximately 75% of patients with traumatic hyphema have a final visual acuity of 20/50 or better.² Vision gradually improves as blood settles to the bottom of the anterior chamber and is eventually resorbed. Most uncomplicated hyphemas will resolve within approximately one week.¹ Certain characteristics of hyphemas such as height and blood color relate to the prognosis. Hyphemas measuring 3-4 mm or less typically have a favorable course, as do hyphemas with light red color. Hyphemas that are 5

mm or more and dark red or black in color have a more guarded prognosis. The dark color of the blood indicates poor circulation of the aqueous humor and lack of oxygen supply in the anterior chamber.¹⁷

The major determining factor in the final visual outcome in traumatic hyphema is usually an associated ocular injury, not the hyphema itself.¹ Factors associated with a poor final visual outcome include the presence of posterior segment injuries such as macular edema, retinal hemorrhage, epiretinal membrane or choroidal rupture. Anterior segment findings including corneal blood staining, traumatic mydriasis, iridodialysis, cataract and lens subluxation are also significant predictive factors of a poor final visual outcome. While the presence of traumatic mydriasis and iridodialysis may not significantly compromise the visual function, they likely reflect the severity of the initial trauma.¹⁹ In a study of 425 individuals with traumatic hyphema, a higher grade of hyphema on presentation and the presence of retinal damage were each associated with a poorer final visual outcome.²⁰

Conclusion

The most common mode of clinical presentation in blunt ocular trauma is hyphema.⁶ Hyphema does not typically cause permanent loss of vision; however, its presence signifies considerable insult to the globe and therefore requires careful follow-up and management. Patient education is essential to minimize complications in the first several days after the injury as well as for the long-term ocular health of the patient. The risk of glaucoma remains years after injury and should always be considered in cases of unilateral glaucoma at any time in life.⁷ The patient in our case description had a good visual outcome. However, due to the area of angle recession and iridodialysis, he is now at higher risk for developing glaucoma and will therefore continue to require careful monitoring throughout his life.

Disclosures

Dr. Dorothy Hitchmoth is a consultant for Annidis Health Systems Corporation and is on the speakers bureau for Zeavision.

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Appendix A: Summary of Examination Findings for the Left Eye

	Visual Acuity	Hyphema Vertical Height (mm)	Anterior Chamber	IOP mmHg	Diagnostic Testing	Medications
8/21/12	20/150	2.2	2+RBC	18	B-scan	Pred QID, Atropine BID
8/22/12	20/80-	2.1	2+RBC	26		Pred QID, Atropine BID, Timolol BID
8/23/12	20/50-	2.0	2+RBC	25	Orbital X-ray	Pred QID, Atropine BID, Cosopt BID, D/C aspirin
8/24/12	20/50+	2.0	3++RBC	25	Anterior segment photos	Pred 6x/day, Atropine BID, Cosopt TID
8/27/12	20/80+	<1.0	2-3+RBC, Flare	34		Pred 6x/day, Atropine BID, Cosopt TID, Acetazolamide
8/28/12	20/100	Trace	3+RBC, Flare	36	Pachymetry: 607 um OD, 662 um OS	Pred 6x/day, Atropine BID, Cosopt TID, Acetazolamide
8/29/12	20/80-	Trace	3+RBC, Flare	21	B-scan	Pred 6x/day, Atropine BID, Cosopt TID, Acetazolamide
8/30/12	20/80	Resolved	2+RBC, Flare	20		Pred 8x/day, Atropine BID, Cosopt TID, Acetazolamide
9/4/12	20/50	Resolved	2+ RBC, Flare	16		Pred 8x/day, Atropine BID, Cosopt TID, Acetazolamide
9/6/12	20/50	Resolved	2-RBC, Flare	18		Pred 6x/day, Atropine QD, Cosopt TID, Acetazolamide
9/13/12	20/40-	Resolved	Trace RBC	17		Pred QID, Atropine QD, Cosopt TID, D/C Acetazolamide
9/20/12	20/30-	Resolved	Trace RBC and flare	17		Pred TID, Cosopt BID, D/C Atropine
9/28/12	20/40-	Resolved	Trace RBC and flare	16		Pred BID, Cosopt BID
10/4/12	20/20-	Resolved	Trace RBC and flare	14		Pred QD, D/C Cosopt, Re-start Aspirin
10/11/12	20/25-	Resolved	Trace RBC and flare	20		Pred QD
10/25/12	20/25+	Resolved	Clear	19		Pred QOD
11/14/12	20/30+	Resolved	Clear	15	Gonioscopy	None

Pred = prednisolone acetate 1% ophthalmic solution; Atropine = atropine sulfate 1% ophthalmic solution; Timolol = timolol ophthalmic solution 0.5%; Cosopt = dorzolamide 2%/timolol 0.5%; Acetazolamide = acetazolamide 500 mg PO BID.

Investigation of an Additional Critical Thinking Outcomes Measure: The Efficacy of Critical Thinking Assessments in Predicting Clinical Success

Julia Appel, OD

Rochelle Mozlin, OD

Abstract

Background: Critical thinking assessment has been noted to be fraught with difficulty especially in the area of clinical care. Guidelines from the Association of Schools and Colleges of Optometry and SUNY College of Optometry's Strategic Plan both stress the need to insure that students are successful critical thinkers. This study aimed to determine the predictive value of written case-based analyses for clinical success.

Methods: Seventy-five optometry students were subjects whose grades on case-based written analyses were compared with their grades in clinic (both overall and in areas specific to assessment and management).

Results: Although positive trends were noted, no predictive value was found between the students' grades on their written analyses and their clinical grades.

Conclusion: Case-based written assignments are one of several tools that can be used to assess a student's critical thinking, but they should not be used at the exclusion of other assessments.

Key Words: critical thinking, clinic

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Introduction

The 2011 report of the Association of Schools and Colleges of Optometry (ASCO), *Attributes of Students Graduating from Schools and Colleges of Optometry*¹, recommends that faculty at optometric institutions “develop, monitor and maintain a set of educational outcomes that: include effective and comprehensive assessment methods that provide accurate and reliable data on the achievement of specific and related outcomes.” The importance of critical thinking as a requirement of a successful practitioner is emphasized in the following excerpts, which define the characteristics of the new Doctor of Optometry:

- The ability to acquire, analyze and apply new information while making reasonable and informed decisions that are consistent with the interests and needs of the patient and broader community
- Problem-solving and critical-thinking skills that integrate current knowledge, scientific advances and the human/social dimensions of patient care to assure the highest quality of care for each patient
- The critical-thinking skills needed to assess the patient's visual and physical status and to interpret and process the data to formulate and execute effective management plans

These recommendations are embedded in the Strategic Plan of the State University of New York, College of Optometry (SUNY Optometry),² which calls for the college “to deliver a customizable professional degree program that ensures active integrated learning while preparing students for problem-oriented patient care.” Critical thinking is a high priority as emphasized by the following objective: “Ensure the curriculum effectively integrates basic and clinical sciences and teaches critical thinking and the principles of evidence-based practice.” (page 6)²

What is “critical thinking?” The process has been described by the American Philosophical Association as follows: “We understand critical thinking to be purposeful, self-regulatory judgment

which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological and contextual considerations upon which the judgment is based.”³ The end result is the ability to make decisions to guide actions during patient care.

Two questions become paramount when acknowledging the importance of critical thinking: 1) how can students be taught to be better critical thinkers? and 2) how can a student’s ability to think critically be assessed? Responses in literature are vast in these areas. In regard to the first question, some older schools of thought state that there is only the need for more experience to advance from competent to expert, but more recent thinking about critical thinking argues that this is not the case. As Groves et al show,⁴ appropriate data collection and content knowledge do increase with experience, but the potential for misdiagnosis is still present despite growth in these other areas. Despite greater teaching emphasis on clinical practice guidelines, Facione and Facione⁵ note the need for critical thinking in order to use protocols appropriately and achieve expected outcomes. Therefore, students must be taught how to think critically in addition to promoting their acquisition of the skills, procedures and content knowledge needed to be successful clinicians.

Teaching strategies that contribute to critical thinking development are summarized well in the Perspectives paper published by the American Dental Education Association (ADEA).⁶ According to the ADEA, instructors should encourage independent thinking via: a) questioning the group members while modeling their own thought processes regarding the most important aspects of each case; b) encouraging students to compare their self-directed learning results to their instructors’ analyses; and c) instituting written assignments that not only require independent research to analyze problems, but encourage formulation of defense for management choices. In an effort to teach critical thinking skills, many of these structural and pedagogical strategies have been incorporated into the curriculum at SUNY Optometry.

It is the second question concern-

ing the assessment of critical thinking skills that has proven to be more vexing. Currently at SUNY Optometry, the only formal assessment occurs in conjunction with patient care activities. An instructor’s assessment of a student’s critical thinking is emphasized on grading forms with separate assessment/grades associated with the student’s ability to formulate appropriate assessments and management plans for patients. A more comprehensive analysis of each student’s clinical competence is derived from grades given to the student by multiple instructors over the course of the semester. According to the ADEA paper,⁶ concerns regarding validity of an instructor’s assessment of a student’s ability to think critically in clinic have been addressed by this grading paradigm. Instructors work with students multiple times on many different kinds of cases over an extended period of time, and as a consequence they are able to assess the student’s basic/clinical knowledge along with the reasoning behind the student’s decisions via appropriate questioning of the student and discussion of their impressions of the student with other instructors. This “global” analysis of competence derived from the impressions of multiple instructors is considered a consensus that carries weight as long as it is coupled with other assessment tools such as student participation in case presentations. However, feedback from students regarding this method of grading for the third-year Integrative Seminar (IS) course revealed concern that a) a student’s reserved nature and discomfort in front of groups makes it difficult for the individual to be actively involved in discussions and b) the grading performed by instructors may not be an accurate reflection of the individual’s abilities due to inter-examiner differences. To alleviate some of these potential assessment conflicts and to incorporate another way of assessing an intern’s clinical reasoning ability, structured case-based assignments have been added to the third-year IS course. This also speaks to the SUNY Strategic Plan goal of teaching and assessing students with unique learning styles.²

Is there evidence that critical thinking ability and clinical success are linked? Multiple studies have shown the pre-

dictive validity of generalized critical thinking ability to determine success in various health professions assessments. Two examples of this are the use of California Critical Thinking Skills Test (CCTST) as a predictor of success on both case-based National Board of Dental Hygiene Exam board scores⁷ and fourth-year clinical optometry grades after completing fourth-year rotations.⁸ However, while previous studies have looked at the ability to use standardized critical thinking tests as predictors of clinical success, there is nothing in the literature looking at case-based analyses that emphasize critical thinking as predictors of clinical acumen.

This study was undertaken to determine if such structured case-based assignments are a viable outcome measurement in the assessment of critical thinking and ultimately successful clinical performance. It was hypothesized that if students’ grades on the structured case-based assignments showed a strong correlation with their clinical grades (specifically their performance on determining appropriate assessments and plans for their patients in real-time, in clinic), then an additional outcome measurement of critical thinking would be identified. Accordingly, this would potentially allow for earlier intervention by helping to identify students struggling in their development as capable clinicians.

Methods

Subjects

The 75 subjects in this study were the members of the third-year class (class of 2014) at SUNY College of Optometry.

Data

Data were collected during both the fall and spring semesters and data/grades were de-identified. Subject performance on three case-based assignments was correlated with Primary Care clinic grades (both overall average and in the specific areas of Case Analysis/Assessment and Management/Plan) and third-year IS grades. All data were collected in adherence to the Family Educational Rights and Privacy Act (FERPA) of 1974 as all gathered protected information was used for educational research purposes and only the Instructor of Record had access to identifiable

grading information.

Setting

Ongoing curricular revisions at SUNY Optometry continue to strengthen critical thinking by focusing on an integrational approach that prepares students for clinical success. It aims to do so by implementing a hybrid of didactic course work with small group seminars that integrate basic science understanding across courses with a strong emphasis on clinical relevance. The IS track throughout the first three years of the curriculum emphasizes the application of clinical reasoning at experience-appropriate levels that increase in complexity as the student learns the material necessary for providing vision care.⁹ Beginning in the first week of optometry school, first-year students are asked to present and discuss cases they have observed in clinic during their small group sessions with the strong support of a faculty instructor as they make links and inferences and try to understand not only the “what” but also the “why” of patient care. They are also given a lecture on evidence-based practice and are asked to develop clinical questions in order to delve deeper into those areas they encounter but in which they have little experience. During their second year, the interns are required to analyze cases presented to them. They are challenged to work in small groups to develop a differential diagnosis and to investigate the best patient care management options utilizing independent searches and their increasing knowledge of navigating appropriate evidence-based resources. They must defend their chosen management plan of the patient in competition with other groups. Starting in the third year, students present cases of patients they have cared for with focus on one to a few primary aspects of the case and knowledge development through independent research. In the ensuing discussion amongst the small group, all participants are evaluated in their ability to contemplate alternative management plans and are encouraged to contribute to the discussion in a purposeful way. The teaching methodology in third year shifts to encourage the students to self-direct their learning in an independent fashion with increasing emphasis on the students

doing the thinking. Third-year students at this juncture are making the transition from receptive learners and data collectors to thinking clinicians. In this way, the learners become active participants in the learning process and in some ways they become instructors by reporting back to the group what they have learned. The end result is a three-year educational process emphasizing the defining characteristics of critical thinking: purposeful, self-regulatory, evidential, conceptual, methodological, criteriological and contextual.³

Determination of Clinic Grades

In the Primary Care clinic, the third-year students are broken into small groups called “pods” consisting of six to seven interns with two faculty instructors. Each pod is scheduled for six hours of patient care and one hour of IS each week. The fall and spring semesters are each composed of eight-week blocks. Over each block, each student will work with each instructor approximately four times. Pod assignments are then shuffled at the end of an eight-week block. This scheduling paradigm gives every third-year student the opportunity to work with and be evaluated by as many as eight faculty instructors over the two semesters. Primary Care clinical evaluations are provided on a weekly basis by the instructor to whom the student is assigned. Instructor teams also provide a summary team evaluation for their interns at the end of each eight-week block. Each semester, 16 to 18 evaluations are generated and averaged to derive each student’s clinic grade.

Evaluations of clinical performance include these five areas:

- Subjective Information/Data (appropriately obtains and documents pertinent information; understands the significance of the patient’s systemic and ocular presentation and history)
- Objective Information/Data (demonstrates the ability to choose and accurately perform appropriate testing based on the patient’s presentation/needs)
- Case Analysis/Assessment (demonstrates understanding of basic and clinical science knowledge as applicable to patient’s presentation

and identifies processes leading to dysfunction and disease)

- Management/Plan (demonstrates understanding and applies current standards of care in all aspects of practice, able to develop an appropriate action plan)
- Professional Responsibility/Elements of Professional Conduct (demonstrates appropriate patient rapport, empathy, ethical practice, time efficiency, conduct, dress and hygiene; accurate, clear and concise chart/notes)

For each of the above key areas of clinical performance assessment, faculty instructors rank each student’s performance according to three descriptors: exceeds expectations, meets expectations and does not meet expectations. Over the course of their third year, as the students gain experience and knowledge, the threshold to meet the expectation level for each descriptor rises accordingly. Each semester, the final clinic grade for these third-year students was determined by calculating the percentage of exceeds expectations, meets expectations and does not meet expectations. This was then translated to both a numerical score (from 0-4) and a letter grade with the following guidelines: >30% exceeds = A (range 3.5-4.0), 20% not met = C (range 2.0-2.75), 30% not met = F (<2.0) and grades for each semester were subsequently averaged.

Determination of Grades for IS

Each student is given a grade for performance in IS collaboratively by their pod’s two faculty instructors at the end of each semester; therefore, over the two semesters they receive four grades from eight instructors. For these third-year students, the case-based assignments were included in their IS grades. Therefore, in the fall, the IS grade was derived from participation, one case-based assignment and a final Power-Point presentation. In the spring, the IS grade was based upon participation and two case-based assignments (**Appendix A**). The average of the fall and spring IS grades was used as the overall grade in IS for our study investigation.

Case-Based Assignments

With the guidance of a consultant, a

rubric was developed to guide the grading of the three case-based assignments. In addition, information regarding the purpose of the exercise: to enhance and evaluate the intern's ability to think critically regarding patient care was also created (**Appendix B**). Both the rubric and information were distributed to the students in advance of their first case-based assignment to enhance their appreciation of the learning outcomes, realize expectations for the assignments, and enable them to maximize their scores. Each case was presented as a patient's chart containing all necessary information including: chief complaint, case history and examination data. Assignment scoring was based on a maximum of 20 points with the following point distribution:

- Ability to use history and exam findings to guide understanding (4 points)
- Ability to develop differential diagnosis/select appropriate diagnosis and demonstrates sound supportive reasoning for each problem identified (4 points)
- Ability to suggest further appropriate testing (4 points)
- Ability to develop management options based on case (4 points)
- Ability to explain evidence for management options based on patient presentation and the literature (4 points)

The cases increased in complexity over the two semesters and incorporated appropriate content based on didactic course work. All three case-based assignments were submitted via Moodle (Modular Object-Oriented Dynamic Learning Environment open-source community-based electronic course management system, www.moodle.com) and were graded by a single individual (the instructor of record for third-year IS and this study's principal investigator). The final grade for the case-based assignments was determined by summation of the scores from each of the three cases with a maximum yield of 60 points.

Statistical Analysis

Data from 75 subjects were utilized

for analysis. All scores were presented as a percentage of the maximum score (from 0-1.00, with 1.00 representing a grade of 100%). The following four variables were provided (the terms in parentheses show the shortened variable names used in the plots):

- Critical thinking case-based assignment grade (ctcases)
- Overall IS grade (isgrade)
- Critical thinking clinic grade for assessment and management (ctclinic)
- Overall clinic grade (clingrade)

Distributions of the four scores were presented graphically using a box-and-whiskers plot. The box in each case extends from the 25th to the 75th percentile, i.e., includes the middle 50% of the data. The solid line within a box shows the median score. The whiskers are drawn to the furthest point that is no more than 1.5 times the length of the box from each edge of the box. Outliers are shown in red and are labeled with the subject identifier.

Analyses of the relationships between scores were done using ordinary linear regression. The correlation between each pair of scores was summarized using the Pearson correlation. P-values for testing whether the Pearson correlation was different from 0 are also pre-

sented. Both confidence intervals and hypothesis tests for the Pearson correlation were performed based on the Fisher transformation.

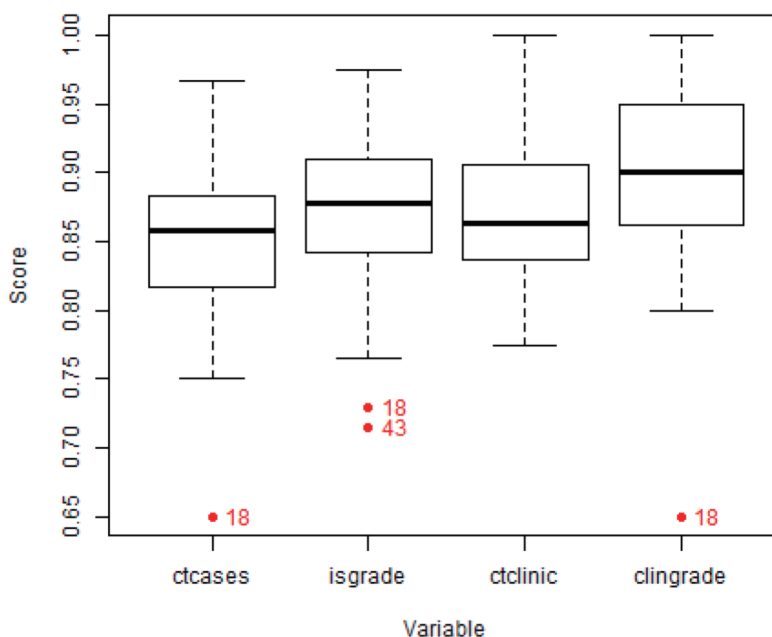
Scatter-plots were used as graphical comparisons for each pair of variables. These plots included a superimposed fitted regression line as well as 95% confidence bands and 95% prediction bands. The confidence bands reflect how well the model has been fitted to the overall dataset. However, as the primary goal of this study was to determine whether the critical thinking case-based assignment grade (ctcase) could predict the critical thinking clinic grade (ctclinic) for individual students, the plots also show 95% prediction bands, which show the ranges of individual ct-clinic scores that would be predicted for an individual with a given ctcase score. More specifically, they show the ranges within which 95% of future predictions are expected to fall. All statistical analyses were performed in R, Version 3.0.2.

Results

The distributions of scores for the four variables are shown in **Figure 1** using a box-and-whiskers plot.

Note: Subject #18 had three out of four scores that were outliers with two of the four being well-removed from the

Figure 1
Distribution of Scores



scores of the rest of the class. Hence, this subject was excluded from calculations of correlations and regression lines because of the undue influence that the single subject might have on the results.

The primary analysis evaluated how well *ctcases* score predicts *ctclinic* score. **Figure 2** shows a scatter-plot of these two variables with a superimposed linear regression line. The plot also shows 95% confidence bands and a 95% prediction interval. The confidence bands reflect how well the model has been fitted; the 95% prediction interval shows the ranges of *ctclinic* predictions for individual subjects for each given *ctcases* score. More specifically, they show the ranges within which 95% of future predictions are expected to fall. The reason they are so much wider than the confidence intervals is because the scatter of the individual points around the fitted line is large, thus when one is trying to predict the *ctclinic* score for a single subject, the variability must be incorporated.

Table 1 shows the summary statistics for the fit of the line and for the Pearson correlation coefficient.

There is a tendency for higher *ctcases* scores to be associated with higher *ctclingingrade* scores as reflected by both the slope and correlations being statistically different from 0 (0 not included in 95% confidence interval). Note also that the intercept is different from 0 indicating that *ctclingingrade* scores tend to be higher than the *ctcases* scores, something that is also apparent from the box plot in **Figure 1**.

Secondary Analyses

Two additional relationships were explored:

- The relationship between the *ctcases* score and the overall *clingingrade* score
- The relationship between the overall *isgrade* score and the overall *clingingrade* score

Figure 3 shows the results for *ctcases* score vs. the overall *clingingrade* score and **Table 2** provides the summary statistics.

There is essentially no difference between this relationship and that seen

Figure 2
Relationship Between *ctcases* Score and *ctclinic* Score

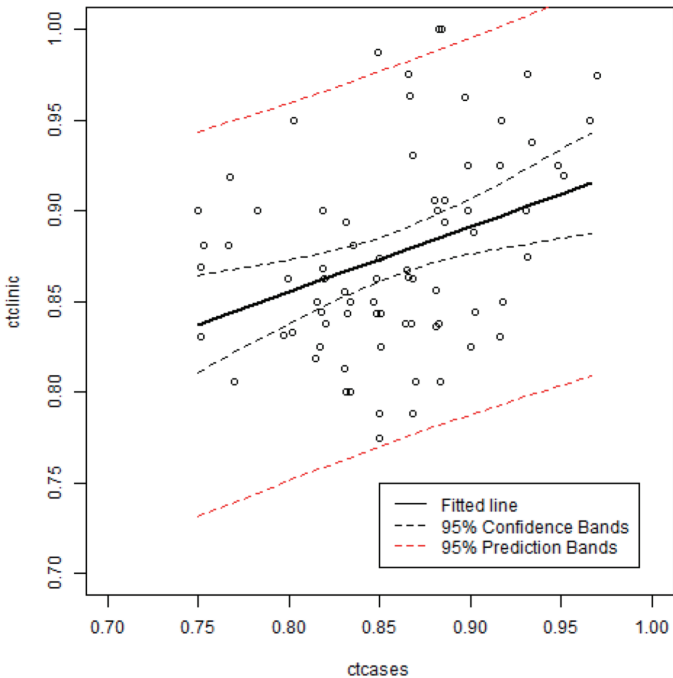
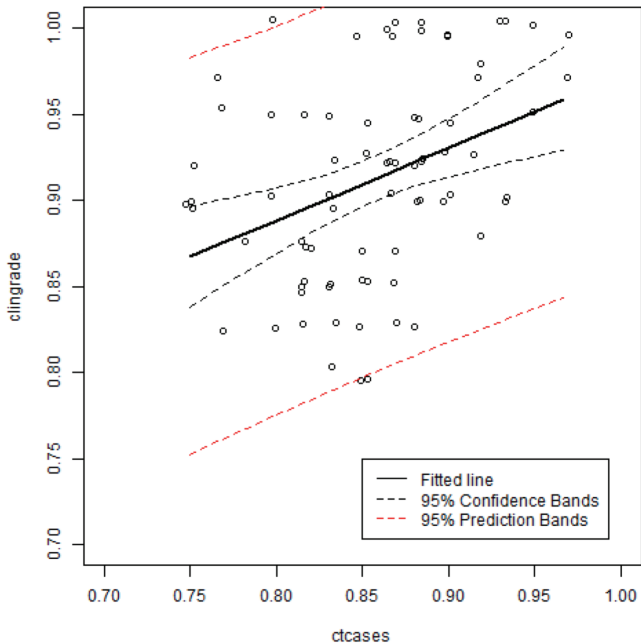


Table 1
Fit Statistics for Modeling *ctclinic* Score as a Function of *ctcases* Score

Parameter	Estimate	95% Confidence Interval
Intercept	0.57	(0.37 - 0.76)
Slope	0.36	(0.13 - 0.59)
Pearson's correlation	0.35	(0.13 - 0.53)

Figure 3
Relationship Between *ctcases* Score and *clingingrade* Score



earlier between the ctcases and ctclinic scores.

Figure 4 shows a comparison of the overall isgrade score vs. the overall clingrade score, and Table 3 provides the summary statistics.

In the case of the overall scores, the ability of the isgrade score to predict the overall clinical score is superior to those seen for the other variables.

Table 4 summarizes all correlations between the variables. For example, the correlation just observed between the clingrade and isgrade of 0.71 is shown when row = clingrade and column = isgrade or vice-versa. The strong correlations seen between ctclinic and clingrade scores and between ctcases and isgrade are partially a result of the fact that ctclinic and ctcases are subcomponents of the overall clingrade and isgrade scores, respectively.

Discussion

Many factors affect the ability to assess critical thinking success and it is important to remember that “qualitative data can inform researchers about intervention effects that are not easily captured by quantitative instruments.”¹⁰ Moderate positive trends are shown among our data sets indicating that case-based assignment success or difficulty can be used as one piece of information to assess overall clinical reasoning ability but it cannot be used as a predictor of clinical success and clinical thinking success. The ability to glean useful information from the case-based analyses is apparent when looking at individual data, as some interns who performed only adequately in clinic performed well on these slower paced, more analytical assignments and others that performed very well clinically achieved only adequate grades on these assignments. In this regard, other strengths and difficulties such as communication skills or willingness to invest time in completion of the assignments are elicited. For example, a subject who performed well in clinic scored poorly on the written task due to writing skills and the inability to clearly express thinking in written form due to English not being the subject’s first language.

Limitations of this study include the fact that the assessment of clinic per-

Table 2
Fit Statistics for Modeling clinicgrade Score as a Function of ctcases Score

Parameter	Estimate	95% Confidence Interval
Intercept	0.55	(0.34-0.72)
Slope	0.42	(0.18-0.67)
Pearson's Correlation	0.37	(0.16-0.55)

Figure 4
Relationship Between isgrade Score and clingrade Score

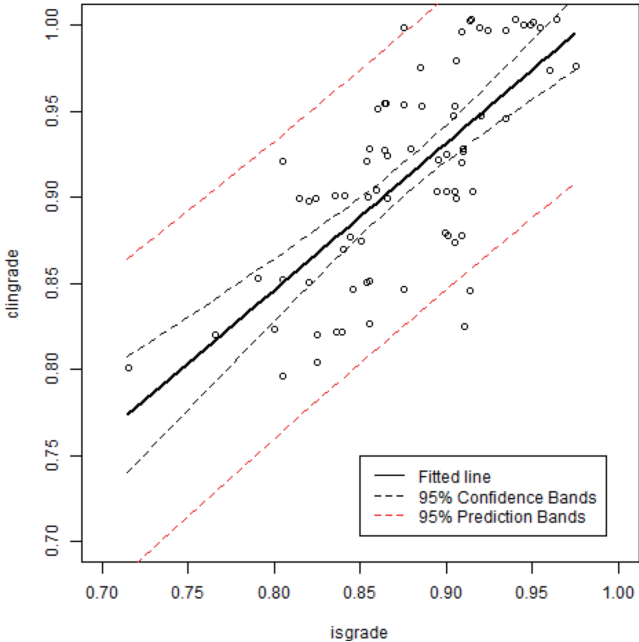


Table 3
Fit Statistics for Modeling clingrade Score as a Function of isgrade Score

Parameter	Estimate	95% Confidence Interval
Intercept	0.16	(-0.01 - 0.34)
Slope	0.85	(0.66 - 1.05)
Pearson's correlation	0.71	(0.58 - 0.81)

Table 4
All Correlations

	ctcases (p=)	isgrade (p=)	ctclinic (p=)	clingrade (p=)
ctcases	1.00	0.64 (<0.0001)	0.35 (0.0024)	0.37 (0.0011)
isgrade	0.64	1.00	0.65 (<0.0001)	0.71 (<0.0001)
ctclinic	0.35	0.65	1.00	0.87 (<0.0001)
clingrade	0.37	0.71	0.87	1.00

formance and IS performance are both provided by the same faculty members. The plotting of the overall IS grade both against the clinical assessment and management grade (.64) and overall clinic grade (.71) are shown to have stronger positive correlations than seen with the case-based analyses. These last data sets may be at least partially skewed by the fact that the same faculty members are providing 60%-80% of overall IS grade and 100% of the clinic-based grades without masking. While attempts are made to minimize personal bias that sometimes accompanies the grading consensus via specific rubrics and multiple graders, there is always the potential for it and such are the well-known pitfalls of clinical evaluation. Also, the lack of masking of the students' written case analyses when graded by the instructor of record has the potential to introduce bias. Future investigations could be designed such that any written analyses are graded without student identification or by an unaffiliated examiner.

Despite the inability to utilize a case-based assessment as a primary predictor of clinical success, third-year IS will continue to employ case-based assignments to teach critical thinking skills. Boshuizen and Schmidt¹¹ reason that students must be given adequate opportunities to test their knowledge and establish connections between concepts in order to detect gaps in their knowledge and critical thinking skills. With the appropriate stimuli and feedback, they will self-direct their learning to fill these gaps. These learning opportunities need not be live patients. Indeed it might be more effective to use structured "paper cases" in which the degree of complexity can be controlled and students can first learn to diagnose and manage more common clinical entities. It should be noted, that the one subject whose data was removed from the study analysis has struggled both clinically and didactically. The results of these case-based assignments demonstrated gaps in both knowledge and critical thinking skills and provided feedback as a first step in remediation.

The use of case reports in teaching has many advantages, which have been summarized as follows by Rivett and Jones:¹²

- The level of complexity and focus of the case can be tailored to the learning needs of the student.
- All students are exposed to the same predetermined learning experience.
- Self-paced and self-directed learning is facilitated by accessibility and portability.
- Accompanying resources can be provided to enhance the learning potential of the case.
- There is no risk to the patient or the student; mistakes can be made with minimal consequences.
- Feedback is available.
- Case reports help instill confidence in the student for real-time clinical work.

There are, however, limitations to the use of case reports to teach critical thinking. Sefton, Gordon and Field¹³ note that case reports fail "to exploit the power of active inquiry learning." When case reports are viewed as additional didactic assignments, students may not spend the time required for independent learning and consolidation. In fact, this perception may have contributed to the lower correlations seen between scores on the case-based assignments and clinic grades.

Faucher, Tardif and Chamberland¹⁴ have analyzed the clinical reasoning of competent vs. expert-level optometrists and their results are not surprising: Expert-level optometrists are more patient-centered, more problem-oriented during the exam, are able to multi-task, and develop a management plan during the entire examination process. They conclude that optometry students must be exposed to multiple, varied and representative clinical cases and must be provided with consistent feedback. Every school and college of optometry, including SUNY Optometry, has a mission, goals and objectives that are consistent with this conclusion as well as with ASCO's recommendations. Determining and measuring clinical opportunities for students to obtain this goal are far easier than assessing whether students have attained competent critical thinking skills. Facione and Facione⁵ point to the need for a diversity of assessment tools including multiple

choice exams and the use of rubrics in both didactic and clinical settings. Perhaps Schuwirth¹⁵ asks the most relevant question: "Is assessment of clinical reasoning still the Holy Grail?" Can critical reasoning be measured as a separate entity using one specific assessment tool? Or should development focus on a programmatic approach that allows a profile of a student's strengths and weaknesses to emerge from multiple sources? Clinical education at SUNY Optometry will be considering these questions as the implementation of the new strategic plan continues to move forward.

Conclusion

Although trends were noted, case-based assignments did not provide a statistically significant predictive value for critical thinking in a clinical environment. Therefore, these assignments cannot be used as a stand-alone outcome measurement to assess the attainment of relevant goals and objectives in SUNY Optometry's strategic plan. Nonetheless, these case-based assignments will remain as a requirement in third-year IS as an important method of teaching essential thinking skills. The Department of Clinical Education is beginning to direct time and energy toward the development of student portfolios, which will enable individualized educational programs. It is likely that various methods of assessment will be required as students choose different pathways to obtain their professional degrees. Perhaps case-based assignments will re-emerge as one of many instruments in an array of assessment tools.

Acknowledgements

The research for this paper was supported by a Starter Grant for Educational Research from the Association of Schools and Colleges of Optometry. Funding for the grant was provided by Vistakon, division of Johnson & Johnson Vision Care, Inc.

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Appendix A: Integrative Seminar Grading Rubrics

Daily Participation (includes intern's own presentations and involvement in general discussion):

Prepared to present cases: 0-6 pts

Presents cases succinctly and in an organized fashion: 0-6 pts

Performs purposeful evaluation of the literature, utilizing evidence-based medicine where possible: 0-6 pts

Participates actively in discussions: 0-6 pts

Shows evidence of experience-appropriate critical thinking: 0-6 pts

(Always 6 pts; Usually 4 pts; Rarely 2 pts; Never 0 pts)

Total 30 pts

Final Presentation: A 10-minute PowerPoint presentation on a topic of interest on a case the intern has seen that includes information on the clinical assessment/management/basic science foundation/use of evidence-based medicine. Each intern will present during the last few weeks of the semester on a schedule set by the faculty. After the presentation is made during the intern's integrative seminar (IS) session, the final presentations will be submitted on Moodle (Modular Object-Oriented Dynamic Learning Environment).

Preparation of presentation: appropriate graphics and fonts, easy to follow (5 pts); basic presentation with no glaring errors (3 pts); misspelling, incomplete data (1 pt)

Presentation: speaks well and engages (5 pts); rarely reads from slides, often looks at audience (3 pts); difficulty connecting with audience (1 pt)

Demonstrates knowledge of topic: excellent (5 pts); adequate (3 pts); poor (1 pt)

Research: high quality, appropriate (5 pts); adequate but does not cite seminal sources (3 pts); poorly researched (1 pt)

Total 20 pts

Case Analysis: Data will be provided. The intern will then independently submit a written analysis of the case on Moodle. See grading rubric below.

Total 20 pts

Integrative Seminar VII Case Analysis Grading Rubric

Able to use history and exam findings to guide understanding:	Identifies most pertinent historical factors/exam findings (4 pts)	Identifies some pertinent factors/findings (2 pts)	Unable to identify pertinent history or findings (0 pts)
Able to develop DDx/select appropriate diagnosis and demonstrates sound supportive reasoning for each problem identified:	Differential is pertinent to patient's presentation and most appropriate diagnoses based on sound reasoning (4 pts)	Correct diagnoses but based on poor reasoning (2 pts)	No differentials are pertinent to the case/ Incorrect diagnoses and poor reasoning (0 pts)
Able to suggest further appropriate testing:	Most/all tests that are relevant (4 pts)	Few tests recommended (2 pts)	None or irrelevant testing recommended (0 pts)
Able to develop management options based on case:	Includes most/all appropriate options (4 pts)	Few management options suggested (2 pts)	Inappropriate management based on case (0 pts)
Able to explain evidence for management options based on patient presentation and the literature:	Utilizes patient presentation and evidence-based care (4 pts)	Gives some evidence but not thorough or inclusive (2 pts)	Unable to provide appropriate evidence for care (0 pts)

Intern:

Result:

Appendix B: Explanation for Case-Based Assignment/Integrative Seminar

Critical Thinking:

This assignment is geared toward getting you to think critically about how you manage your patients. Success in critical thinking is essential to becoming an accomplished clinician. The process has been described by the American Philosophical Association in 1990 in its statement:

“We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based...”

In short, it means we have to examine our thinking process so that we are making our judgments based on applying what we know in light of all possibilities in an open-minded and reflective way but which is based firmly on evidence. We are internally talking through our thinking process in real time.

For this assignment, you will use the constructs of critical thinking (also known as clinical reasoning or clinical judgment) to build a written analysis of a case, thereby achieving the following learning outcomes:

Learning Outcomes:

1. Students will identify pertinent Hx and findings that should be addressed in this patient's care.
2. Students will interpret and assess the results to determine an inclusive differential diagnosis (min 2 and max 4 differentials) for all issues (max 4 issues) pertinent to the patient's presentation (if no differential exists, then say so). They will choose the most likely diagnosis and explain their thought process regarding this decision.
3. Students will identify additional testing to help support/define the likely diagnosis (max 4 tests.)
4. Students will be able to provide inclusive management options for each problem/Dx identified based on the case.
5. Students will explain and justify their management plan supported by didactic knowledge and independent evidence-based research.

Example:

A 54 y.o. Type II diabetic patient presents for care with reduced acuity in the left eye of recent onset.

1. Student will need to identify any issues in the Hx that could contribute to this (ex: efficacy of medical control of the patient's DM, prior retinal complications of diabetes, prior trauma, loss of most recent eyeglasses, etc.) as well as findings in the exam (findings such as uncorrected refractive error, the presence of a cataract OS, large anisometropia or strabismus, parafoveal retinal hemorrhages and thickening) to help develop an inclusive differential Dx.
2. Students will need to look at refractive error, visual acuity and ocular health results to determine the most likely contributing factor and must explain their reasoning (Ex: refractive error shows minimal change and does not increase BVA, the large anisometropia is longstanding and amblyopia is unlikely cause of the recent onset of the VA reduction, cataract is mild and is not consistent with the reduced VA. Therefore, it is most likely the CSME/DR that is the cause of the reduced BVA).
3. Students will suggest additional testing (such as an OCT and/or FA in the presence of CSME, etc.)
4. Students will discuss appropriate management options regarding the acuity and disease processes that were identified as issues requiring intervention.
5. Students will explain how the patient should be managed (Ex: monitor yearly, refer to retinal specialist, etc.) and use class notes and landmark studies to justify their recommendations for management (Ex: according to our notes in Ocular Disease II, the best way to manage this patient is...and this is supported by the ETDRS result which states that...).

The above process will be applied to each diagnosis you believe requires management or intervention. Answer all questions. Do your best to explain your thinking.

See Appendix A for grading rubric.

Ocular and Generalized Myasthenia Gravis: A Teaching Case Series

Stephanie A. Klemencic, OD, FAAO

Jessica Condie, OD, FAAO

David Mei, OD

Abstract

Myasthenia gravis is an autoimmune disease affecting acetylcholine receptors in skeletal muscle. Ocular symptoms include variable ptosis, diplopia and/or blurred vision. Ocular manifestations may be the initial symptoms in undiagnosed disease, prompting patients to seek eye care. Symptoms of shortness of breath or difficulty swallowing may indicate myasthenic crisis, a life-threatening condition. We present two cases of myasthenia gravis, one with ocular and the other with generalized disease. These teaching cases exemplify the importance of optometric in-office history skills, diagnostic testing and clinical decision-making necessary to effectively diagnose and manage emergent and non-emergent cases of myasthenia gravis.

Key Words: diplopia, ptosis, ocular myasthenia gravis, generalized myasthenia gravis, myasthenic crisis

Background

The following case reports are to be used as a teaching guide for optometry students and residents and are relevant for all levels of training. Myasthenia gravis can be a diagnostic challenge because it mimics any pupil-sparing ophthalmoplegia. Neuromuscular anatomy and physiology are reviewed. Ocular and generalized findings for myasthenia gravis are presented as well as the most current treatment options available. These cases exemplify the importance of optometric in-office history skills, diagnostic testing and clinical decision-making necessary to effectively diagnose and manage emergent and non-emergent cases of myasthenia gravis.

Student Discussion Guide

Case Descriptions

Case 1

A 67-year-old white male presented to the urgent care optometry clinic reporting sudden onset right eye ptosis and binocular, vertical, diplopia, worse at the end of the day, of one week duration. (**Table 1**) The patient denied difficulty swallowing, breathing, hoarseness or generalized weakness. His medical history was positive for hypertension, atrial fibrillation and high cholesterol. He reported good compliance and control of these conditions with atenolol, simvastatin, Niaspan, and coumadin. He was a non-smoker and had no drug allergies. He was oriented to person, place and time.

Due to the variable and fatigable ptosis and diplopia, which improved with ice pack testing, and without symptoms of generalized involvement, the patient was diagnosed with presumed ocular myasthenia gravis. The following blood work was ordered: acetylcholine receptor antibody (AChR) test and thyroid function tests (T3, T4 and TSH). A chest CT was also ordered to rule out thymus gland abnormality. AChR antibody testing was positive and thyroid function tests returned normal. The chest CT was normal, with no evidence of thymoma. The patient was referred to a neurologist, who confirmed the diagnosis, for treatment and management of his ocular myasthenia gravis. He was started on a course of oral pyridostig-

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Table 1
Case 1 Initial Presentation

	OD	OS
Best-corrected visual acuity	20/20	20/20
External exam	Ptosis (variable); + orbicularis oculi weakness; + Cogan's lid twitch	Normal
Pupils	ERRL, -APD	ERRL, -APD
Extraocular motility	Full	Full
Confrontation visual field	FTFC	FTFC
Cover test		4-16 prism diopter intermittent, left hypertropia distance and near; variable and fatiguing
Ice pack test	See Figures 1 & 2	See Figures 1 & 2
Prolonged upgaze test	See Figures 3 & 4	See Figures 3 & 4
Biomicroscopy	Normal	Normal
Intraocular pressure (GAT)	14 mmHg	14 mmHg
Dilated fundus exam	Pink, flat, optic nerve distinct borders; 0.3 c/d; flat, intact retina 360	Pink, flat, optic nerve distinct borders; 0.3 c/d; flat, intact retina 360

FTFC = full to finger count; ERRL = equal, round and reactive to light; APD = afferent pupil defect; GAT = Goldmann applanation tonometry.

Figure 1
Case 1: Before Ice Pack Test

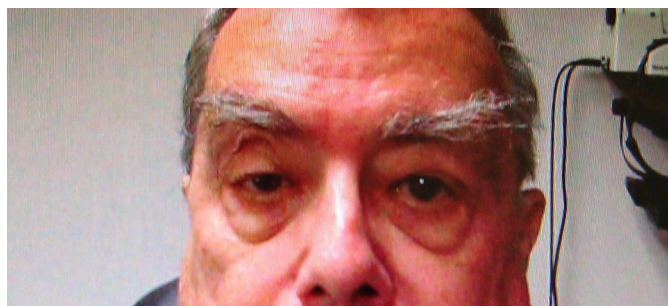


Figure 2
Case 1: After Ice Pack Test

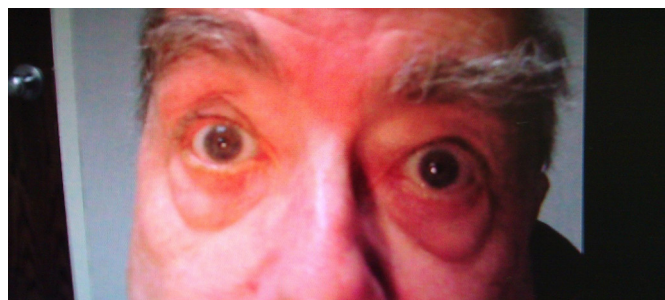


Figure 3
Case 1: Before Sustained Upgaze Test

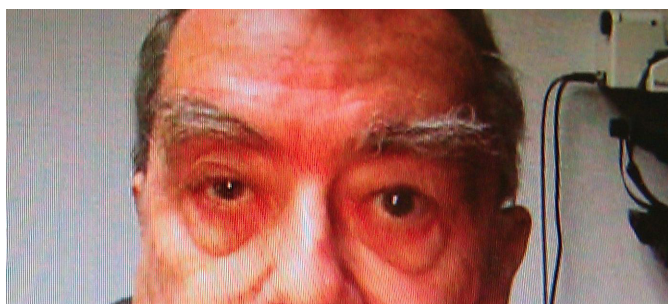
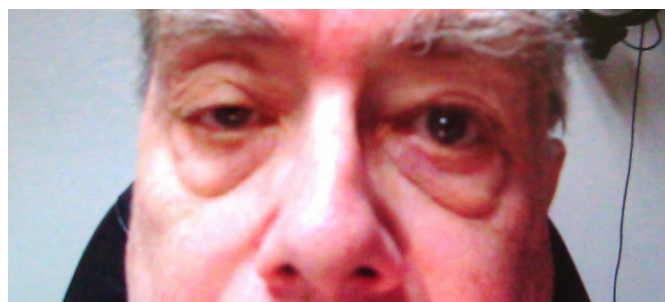


Figure 4
Case 1: After Sustained Upgaze Test



mine, which led to complete symptom resolution.

Case 2

A 34-year-old African American female presented with complaints of intermittent diplopia and ptosis, worse at the end of the day, for the last year. (Table 2) The diplopia fluctuated between horizontal, vertical and diagonal. She described her left eye as “lazy,” and stated it had been getting progressively worse. She also reported foreign body sensation and tearing in her left eye for the last two months. Upon questioning, she complained of generalized muscle weakness, difficulty swallowing and breathing for the last three months. Her primary care physician had treated her for bronchitis without resolution of the symptoms. She was sent to an otolaryngologist, who treated her for post-nasal drip with the same result. The patient’s ocular history was remarkable for spectacle wear at distance and near. Her medical history included osteoarthritis, herpes simplex type two, depression, keloidosis and seasonal allergies. She was taking Benadryl for seasonal allergies and naproxen for osteoarthritis. She was a non-smoker and was oriented to time, place and person.

Due to the variable and fatigable ophthalmoplegia, ptosis, positive Cogan’s lid twitch and systemic symptoms, the patient was diagnosed with presumed generalized myasthenia gravis with ocular involvement. The left eye was also diagnosed with exposure keratopathy secondary to incomplete blink. Both eyes were treated with one drop of artificial tears four times per day and lubricating ointment applied to the lower cul-de-sac before bedtime due to weakness observed with the orbicularis oculi muscles (OS>OD). The patient was immediately sent to the emergency room because of symptoms of dyspnea, dysphagia, and concern for immediate risk of mortality in myasthenic crisis. The patient was given a referral letter reporting concern for myasthenic crisis with documentation of her ophthalmological findings and systemic complaints to present to the emergency room when she arrived. The patient was told to follow up in the eye clinic in one month.

The patient was admitted to the hos-

Table 2
Case 2 Initial Presentation

	OD	OS
Best-corrected visual acuity	20/20	20/25
External exam	Ptosis (variable); + orbicularis oculi weakness; + Cogan’s lid twitch	Ptosis (variable, but consistently worse than OD); + orbicularis oculi weakness; + Cogan’s lid twitch
Pupils	ERRL, -APD	ERRL, -APD
Color vision (Ishihara)	normal	normal
Extraocular motility	Restriction 360; see Figure 5	Minimal infraduction only; see Figure 5
Exophthalmometry	24 mm	24 mm
Forced duction	negative	negative
Confrontation visual field	FTFC	FTFC
Prolonged upgaze test	Worsening of ptosis	Worsening of ptosis
Ice pack test	Improvement of ptosis	Improvement of ptosis
Biomicroscopy	Normal	2+ interpalpebral PEE
Intraocular pressure (GAT)	21 mmHg	21 mmHg
Dilated fundus exam	Pink, flat, optic nerve distinct borders; 0.3 c/d; flat, intact retina 360	Pink, flat, optic nerve distinct borders; 0.3 c/d; flat, intact retina 360

FTFC = full to finger count; ERRL = equal, round and reactive to light; APD = afferent pupil defect; GAT = Goldmann applanation tonometry; PEE = punctate epithelial erosions.

Table 3
Case 2 Follow-Up #1

	OD	OS
Best-corrected visual acuity	20/20	20/20
External exam	Ptosis variable and orbicularis oculi weakness but improved from last exam; see Figure 6	Ptosis variable and orbicularis oculi weakness but improved from last exam; see Figure 6
Pupils	ERRL, -APD	ERRL, -APD
Extraocular motility	Minimal restriction 360; see Figure 6	Moderate restriction primarily in adduction; see Figure 6
Confrontation visual field	FTFC	FTFC
Biomicroscopy	Normal	Normal
Intraocular pressure (GAT)	18 mmHg	18 mmHg

FTFC = full to finger count; ERRL = equal, round and reactive to light; APD = afferent pupil defect; GAT = Goldmann applanation tonometry.

pital the same day. Generalized myasthenia gravis with myasthenic crisis was confirmed. Sixty milligrams of Mestinon and 50 mg of prednisone were initiated, and the patient was observed in the hospital for three days.

Case 2: Follow-Up #1

The patient returned to the eye clinic one month later. (Table 3) She reported

the diplopia and ptosis had improved since initiation of treatment. She also noted improvement of the dyspnea and dysphagia without complete resolution, and was under the care of a neurologist whom she was seeing every two weeks. The patient’s ocular medication included artificial tears, one drop instilled two times per day in both eyes. The patient

Figure 5
Case 2: Initial Visit, Nine Cardinal Fields of Gaze

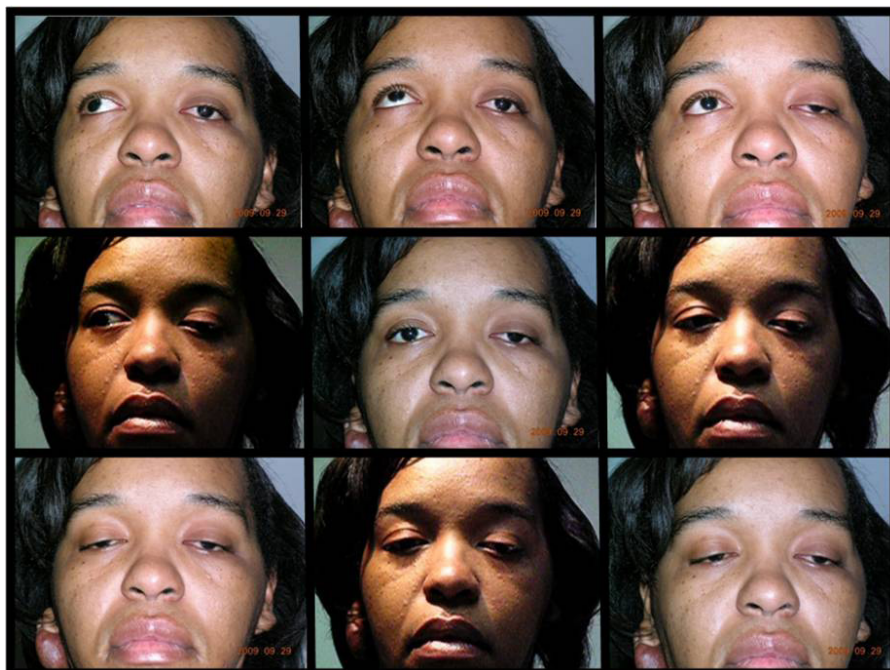
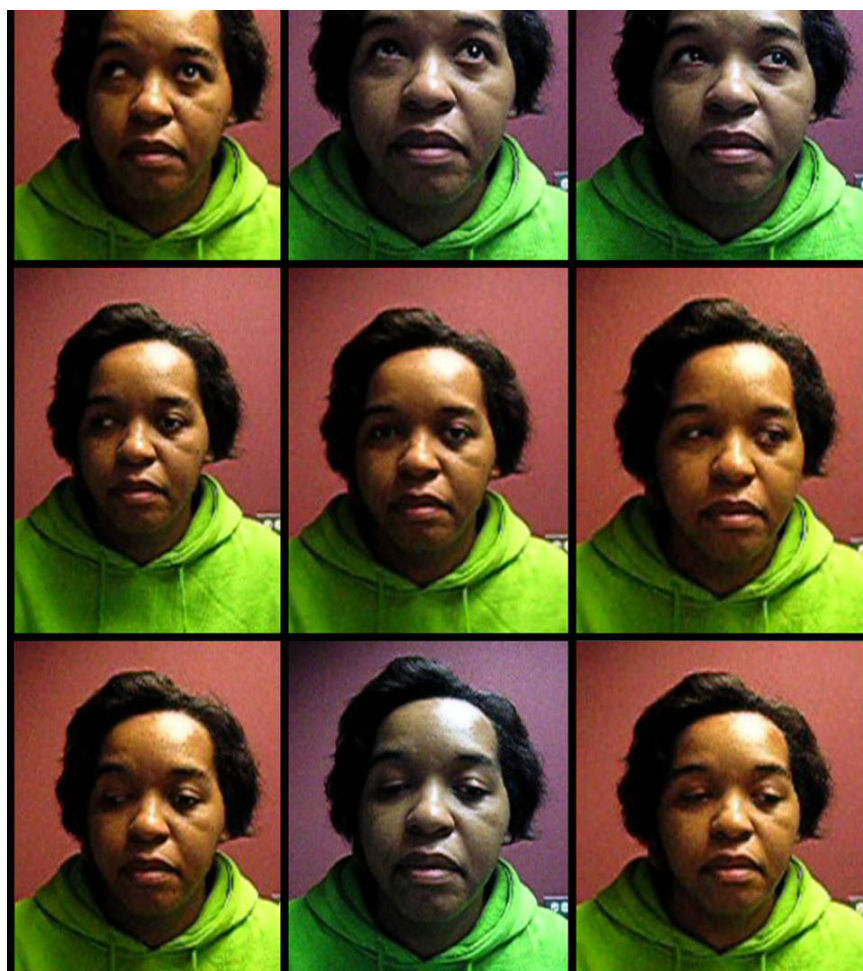


Figure 6
Case 2: One Month Follow-Up After Treatment



was not applying the lubricating ointment before bed as instructed at the last exam. The patient's systemic medications now included Mestinon 50 mg per day and 60 mg of prednisone per day. A CT of the chest was performed and no thymus gland abnormality was observed. The patient was scheduled to follow up with neurology in one month.

The patient was assessed with generalized myasthenia gravis with ocular involvement with significant improvement of ocular signs with systemic therapy. Both eyes were assessed for exposure keratopathy. The patient was instructed to continue using artificial tears four times per day OU, and instructions for the lubricating ointment at bedtime OU were reinforced. The patient was instructed to continue follow-up with neurology for systemic treatment of the generalized myasthenia gravis and to follow up in the eye clinic in three months.

Learning Objectives

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

1. Understand the pathophysiology of myasthenia gravis
2. Take an appropriate ocular and systemic history for patients presenting with diplopia
3. List and differentiate key ocular and systemic signs and symptoms associated with myasthenia gravis
4. Perform in-office diagnostic testing to help diagnose myasthenia gravis
5. Differentiate myasthenia gravis from other ophthalmoplegias
6. Correlate clinical findings with the patient history to determine diagnosis
7. Understand ocular and systemic treatment options for myasthenia gravis

Key Concepts

1. Understand the neuromuscular anatomy and physiology in myasthenia gravis
2. A history of variable and fatigable muscle weakness suggests myasthenia gravis

3. Recognize clinical findings of myasthenia gravis
4. Understand the risks and benefits of various diagnostic testing for myasthenia gravis
5. Differentiate between emergent and non-emergent referrals for patients presenting with signs and symptoms of myasthenia gravis
6. Understand the significance of a multidisciplinary approach when managing individuals with myasthenia gravis
7. Understand how to select clinically appropriate problem-based testing

Discussion Points

A. Knowledge of Potential Clinical Findings

1. Describe the classic signs and symptoms of ocular myasthenia gravis.
2. Describe the classic symptoms of systemic myasthenia gravis.
3. Describe the mechanism of action of the pharmaceutical agents involved in the diagnosis and treatment of myasthenia gravis.
4. What in-office tests can optometrists perform to aid in the diagnosis of myasthenia gravis?
5. What history questions should one ask every patient suspected of having myasthenia gravis?
6. What is the definition of myasthenic crisis?
7. What medications should be avoided in patients with myasthenia gravis?

B. Comprehension of Clinical Data

1. What diagnostic tests were done in this case to help diagnose myasthenia gravis?
2. How does one differentiate between myasthenia gravis and other ophthalmoplegias?
3. What blood work and other diagnostic tests should be ordered in patients suspected to have myasthenia gravis?

C. Management

1. What are the classes of medication used to treat myasthenia gravis?
2. What are the goals of treatment for myasthenia gravis patients?
3. How do you determine what warrants an emergent vs. non-emergent referral?
4. What other physicians should co-manage a patient with myasthenia gravis?
5. How do you manage the patient's ocular symptoms?
6. What surgical treatment options are available?

D. Patient Education

1. What are potential consequences associated with non-compliance to the treatment plan?
2. What pertinent information should be used to educate patients on the condition?
3. Discuss appropriate responses to a patient's anxiety about the ocular and/or systemic condition, and long-term disease consequences associated with the condition.

Educator's Guide

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

Literature Review

Myasthenia gravis (MG) is an autoimmune disease targeting nicotinic acetylcholine (ACh) receptors in post-synaptic connections of skeletal muscle.^{1,2,3} It affects voluntary skeletal muscle either only in the eye (ocular) and/or the entire body (generalized). The process by which muscular weakness manifests is a result of competitive inhibition. Anti-acetylcholine receptor antibodies block or destroy ACh receptors, thus decreasing the number of sites available for ACh binding;² therefore, the initial weakness observed is transient and improves with rest.¹

It is estimated that 85-90% of MG cases present with ocular symptoms; 20-50% of cases have been reported as purely ocular. Ocular myasthenia gravis (OMG)

is considered a separate diagnosis from generalized MG; yet, most cases of generalized MG have ocular symptoms.¹

Epidemiology

The prevalence of MG is approximately 20/100,000/year in the United States.² MG has no racial or geographic predilection and can affect any age group, although it is rarer in the first or after the sixth decade of life.^{2,4} Onset tends to occur at an earlier age in women than in men. In patients with onset prior to age 40, women tend to predominate, whereas over the age of 50 men predominate. In generalized MG the female to male ratio is 3:2; however, in OMG men are more frequently affected, especially after age 40.^{2,4} MG in the North American and European pediatric population comprises 10-15% of MG cases. However, in Asian countries, up to half have an onset before 15 years of age, and most are purely ocular MG.³

Pathophysiology

Acetylcholine is a neurotransmitter that stimulates nicotinic ACh receptors at the postsynaptic muscular junction resulting in muscle contraction.² Neuromuscular synapses are initiated by action potentials that depolarize motor nerve axons and cause an increase in calcium permeability. This increase in permeability elicits the release of acetylcholine into the synaptic cleft. ACh diffuses across the synaptic space and binds to the ACh receptors on the crests of the convoluted folds located on the post-synaptic membrane. This opens the receptor's ion channels and depolarizes the post-synaptic membrane causing the muscle to contract. Upon completion of each synapse, ACh is removed from synaptic space by diffusion and acetylcholinesterase enzyme activity.⁴

In MG, autoantibodies are directed against the ACh receptors at the endplates of neuromuscular junctions. They prevent neuromuscular synapses, characterizing the muscle weakness in MG.^{4,5} The pupillary sphincter muscle does not have nicotinic ACh receptors; therefore, the pupils are not affected.²

The production of autoantibodies against ACh receptors in MG is a T-cell dependent process due to a breakdown in the immune system's recognition of self-antigens. It is not understood why this occurs, but several factors indicate

that thymus gland abnormalities (thymus hyperplasia or thymoma) are important. First, this theory is supported by the fact that thymectomy alters the course of the disease. Second, there are histopathologic changes to the thymus in up to 85% of patients. Third, Ach receptor antibody producing cells can be found in the thymus, bone marrow and peripheral blood. The latter two explain why thymectomy changes the course of the disease but is not curative.⁵

Clinical Presentation and Diagnostic Testing

Fifty to eighty percent of MG patients present with visual complaints of diplopia or ptosis. Half of the patients that present with ocular signs progress to generalized MG weakness in six months and 80% will generalize within two years. The disease will likely be limited to ocular MG if there are no generalized symptoms past three years.¹

The muscle weakness seen (generalized or ocular) is variable in nature, often increased at the end of the day or after sustained, repetitive muscle contraction, and improves with rest.⁸ Weakness is worsened with exposure to heat, infection and stress.³ The weakness typically involves specific skeletal muscle groups. The distribution is generally: ocular (extraocular muscles, levator palpebrae superioris, orbicularis oculi), bulbar (speech, swallowing chewing muscles), limb extremities (arms more affected than legs), neck muscles, and respiratory muscles in the chest.^{2,3}

Generalized MG can present in a variety of additional ways. Bulbar muscle involvement can be seen in 60% of patients, presenting as fatigable chewing, painless dysarthria (impaired speech) and dysphagia (difficulty swallowing).^{3,9} These signs occur due to weakness of palatal, facial and oro-pharyngeal muscles. Changes in facial expressions and flattened nasolabial fold may be seen, giving the patient an "expressionless" appearance. Weakness may also occur in axial and limb muscles. When these are involved, the patient may present with unsteady gait and weakness of arms, hands, legs and neck.⁴ Neck muscles are commonly affected, with the weight of the head overtaking the extensor muscles, producing a "dropped head syndrome."³

Respiratory muscle weakness can lead to myasthenic crisis, which can be life-threatening. Myasthenic crisis is defined as acute respiratory failure due to worsening MG, requiring mechanical ventilation.¹⁰ Symptoms of respiratory failure include dyspnea (shortness of breath), dysphagia, tachypnea (rapid breathing), or bradypnea (slowed breathing). It can be precipitated by infections and certain medications such as aminoglycosides, telithromycin, neuromuscular blocking agents, magnesium sulfate, beta blockers, and fluoroquinolone antibiotics.³ Not every patient with an exacerbation of MG requires mechanical ventilation, but all need close monitoring and immediate access to resuscitation facilities.¹⁰

Ptosis is the most frequent initial symptom of ocular and generalized MG. Ptosis may be unilateral or bilateral and is often asymmetric between the two eyes. Ptosis in MG has clinically distinct characteristics that are absent from other causes: it is variable and fatigable. A fatigue test may be performed several ways. One includes having the patient perform any physical activity, such as climbing a flight of stairs. It is followed by re-evaluation of signs and symptoms of ocular MG. The most common sign is worsening of the ptosis.¹ Another fatigue test has the patient look up for 30 seconds and then return to primary gaze to fatigue the levator. The examiner looks for lid lag or an increase in ptosis, known as Pseudo Von Graefe's sign.^{1,8} Some examiners look for levator fatigue by having the patient look in extreme upgaze for 1-2 minutes. A positive prolonged upgaze test result is an increase in ptosis while the eyes are in upgaze.¹

If one eyelid is manually elevated, the contralateral upper eyelid becomes more ptotic due to Hering's law of equal innervation. This has been labeled "see-saw ptosis." Cogan's lid twitch is frequently seen in MG and occurs when the eyes are rapidly moved from down gaze to primary gaze. This is generally tested by having the patient look down for 15 seconds and then look at a target in primary gaze.⁷ Upon returning to primary gaze, the upper eyelid overshoots and elevates excessively before returning to its ptotic state. This is attributed to the fatigability and rapid recovery of a myasthenic muscle.⁸

Diplopia, secondary to paresis of extraocular muscles, is the second most frequent initial symptom of ocular and generalized MG. Like ptosis, the ophthalmoplegia worsens at the end of the day or upon exertion. It may mimic any disorder of eye movements or exhibit complete external ophthalmoplegia. Reduced accommodative amplitudes, facility, and near point of convergence stamina may also be associated in MG patients.^{1,8}

Orbicularis oculi weakness is also a common finding and can be assessed by having the patient tightly squeeze the eyelids shut while the examiner uses finger pressure to attempt to pry open the eyelids. A positive result is a successful attempt to overcome the blepharospasm. In a normally functioning orbicularis oculi muscle, the examiner should not be able to overcome the tight lid closure by finger pressure alone.¹

Corneal exposure is rarely a problem, but punctate keratitis can occur due to incomplete closure of the lids during blinking. Bell's phenomenon (protective measure of eyes rolling up and laterally during forced eyelid closure against resistance) may also be diminished or absent, usually consistent with the amount of upgaze restriction.

Saccadic movements can be abnormal. A common observation in MG patients is hypometric (undershooting) large saccades and hypermetric (overshooting) small saccades. This is speculated to be the central nervous system's adaptation to muscle weakness. Nystagmus can also be seen in MG and may be unilateral, bilateral, horizontal or vertical in presentation.⁸

Optometrists may use simple, non-pharmacologic, screening tests to aid in the diagnosis of MG. The ice pack test is performed by placement of an ice pack across the patient's eyes for two to five minutes. The localized decrease in temperature slows the breakdown of acetylcholine, increasing its availability in the neuromuscular junction. The clinician then looks for improvement of ptosis or ophthalmoplegia after removing.³ A positive result is an improvement in the ptosis of greater than 2 mm.¹

The sleep test requires the patient to lie in a quiet dark room for 30 minutes with his/her eyes closed. Having

the patient rest reduces the demand for acetylcholine. Also, the 30-minute rest time allows for replenishing of available acetylcholine. A positive result is any improvement of ptosis and/or eye movement deficit.^{1,3}

Some examiners may ask patients to take at-home, full-face, early morning and late evening pictures for three days. Lid position and ocular alignment are evaluated. If ocular signs of MG are present, there will be a worsening of the ptosis and/or ocular misalignment later in the day.⁸

Pharmacological testing using intravenous edrophonium chloride (Tensilon test) is considered the gold standard diagnostic test for MG. Edrophonium inhibits the enzyme acetylcholinesterase and results in an increase in acetylcholine at neuromuscular junctions. A positive test results is a decrease in muscle weakness usually observed in levator function or ocular motility. Onset of action begins in 30-60 seconds and effects usually subside in less than five minutes due to rapid hydrolyzation. During the test, blood pressure and electrocardiographic monitoring are sometimes recommended because of the rare risk of bradycardia, hypotension and cardiac arrest. Mild side effects of edrophonium include epiphora, perioral fasciculations, salivation, mild sweating, abdominal cramps, vomiting and flush.³ Sensitivity of the test using ptosis measurement has been reported as high as 86-97% in OMG and 82-100% in generalized MG. Extraocular muscle movement did not respond well in most studies. False positives have been reported in Lambert-Eaton syndrome, botulism, Guillain-Barre syndrome and other cranial neuropathies.⁴

Serologic testing may also be used to confirm the diagnosis of MG. An elevated acetylcholine receptor (AChR) antibody titer confirms the diagnosis. However, obtaining a negative titer does not exclude the disease. 15% of generalized MG patients have no detectable antibodies to AChRs, meaning they are "seronegative." About half of ocular MG patients are seropositive. Titers in seropositive patients cannot be used to predict the severity of the disease as levels of the antibody correlate poorly with clinical status.^{1,2} Recent studies have shown sensitivities of 98-99% in

generalized MG and 40-77% in OMG. Rarely, a false positive titer is found in first-degree relatives of MG patients or other autoimmune diseases.¹¹

Research has shown antibodies to muscle-specific kinase (MuSK) are found in 40-70% of seronegative AChR antibody patients. No positive MuSK titers were found in patients with positive AChR antibody titers. Reports also found no patients with strictly OMG to have positive MuSK titers. Clinicians are using this titer when AChR antibody testing is negative.¹² This subgroup of seronegative AChR antibody patients with MuSK-positive MG have a marked female predominance and frequent oculo-bulbar weakness leading to respiratory crisis.²

Electrophysiological testing such as single fiber electromyography (SFEMG) is the most sensitive diagnostic test for MG and can be helpful in confirming the diagnosis for seronegative patients.^{2,3} It is done by using a special needle electrode that allows identification of action potentials from individual muscle fibers.³ However, this test is not readily available in every community, and abnormalities are not specific for MG.^{2,3}

Repetitive nerve stimulation is used to assess neuromuscular transmission. It is done by supra-maximally stimulating the nerve. A 10% decrease between the first and the fifth evoked muscle contraction is diagnostic for MG. However, this test lacks the sensitivity as compared to SFEMG. It is abnormal in 75% of patients with generalized MG and 50% of patients with OMG.³

A CT or MRI of the chest with attention to the thymus gland is also performed to rule out the presence of thymoma. MG also often coexists with thyroid disease, so thyroid function tests are also obtained in patients with MG.³

Differential Diagnoses

The diagnosis of myasthenia gravis may be a challenge because it mimics any pupil-sparing ophthalmoplegia. MG should be considered in any patient presenting with diplopia and/or ptosis. However, the keys to diagnosis are the variable and fatigable signs and symptoms and that they improve with rest. The pupils are not involved in patients with myasthenia gravis. Keeping that information in mind, other causes of

diplopia and/or ptosis should be considered. Thorough case history and clinical exam may help rule out the differentials below as they will not demonstrate variability or fatigability and some may have pupil involvement, thus helping to differentiate from myasthenia gravis:¹

- Mechanical: levator aponeurosis dehiscence, involutional, iatrogenic/ocular surgery, trauma, cicatrization, eyelid mass
- Myogenic: Chronic progressive external ophthalmoplegia, myotonic dystrophy, oculopharyngeal dystonia
- Neurogenic: multiple sclerosis, Horner's syndrome, cranial nerve palsies, internuclear ophthalmoplegia
- Mass: thyroid orbitopathy, idiopathic orbital inflammation, orbital neoplasia
- Pseudoptosis: enophthalmos, hypotropia, contralateral lid retraction

Treatment and Management

MG must be treated aggressively, and therapy is individualized to each patient. Treatment early in the course of the disease provides the best overall clinical response. Long-term medical and surgical treatments are used to manage the disease.³

Medical treatment includes palliative treatment in the form of acetylcholinesterase inhibitors and immunosuppressive therapy. Surgical treatment includes thymectomy. The goals of treatment are to prevent mortality with the fewest side effects and to improve the patient's quality of life by remission of symptoms and lowering the risk of transition from ocular to generalized MG.³

Palliative Treatment

Acetylcholinesterase inhibitors such as pyridostigmine bromide (Mestinon) and neostigmine bromide (Prostigmin) are used as first-line treatment to relieve muscle weakness in MG. The mechanism of action works to prevent the hydrolysis and breakdown of Ach in neuromuscular junctions. With more Ach available in the neuromuscular junctions, there is an improved efficiency activating the remaining viable Ach receptors. The onset of action for

pyridostigmine, the most commonly used acetylcholinesterase inhibitor, is within 15-30 minutes orally and two to five minutes intravenously. The duration of action is six to eight hours orally and two to three hours intravenously.¹³ Side effects include gastrointestinal disturbance, pallor, cold sweats, epiphora, increased urinary urgency and muscle weakness. Most patients have symptomatic relief but do not have disease remission. Very seldom is this used as monotherapy. Immunosuppressive agents are needed to suppress the ongoing immune attack on the remaining Ach receptors.¹⁴

Long-Term Immunosuppressive Treatment

Corticosteroids such as prednisone are usually the first recommendation for immunosuppression in patients with moderate to severe generalized disease and have been shown to lower the risk of progression from OMG to generalized disease.^{3,15} There is no established protocol for initiation of treatment. Some clinicians advocate starting the patient on high-dose steroid treatment until remission is reached, then tapering when symptoms are improved. Others recommend starting with alternate day treatment and gradually increasing the dosage until remission to limit corticosteroid complications. Fifty percent of patients develop worsening of weakness in the first month, usually within the first few days after initiation of corticosteroids. Certain high-risk generalized myasthenia gravis patients, such as those in myasthenic crisis, are required to remain hospitalized during initiation of treatment.⁹ Side effects include obesity, hypertension, diabetes, opportunistic infections, osteoporosis, glaucoma, cataracts and corneal ulcer. Side effects are dependent on dosage and duration of treatment.⁹

Azathioprine (AZA) is a purine analogue that inhibits the synthesis of nucleic acids thereby interfering with T-cell and B-cell proliferation. AZA is used as monotherapy or as an adjunct to corticosteroids.¹⁰ Improvement in symptoms is gradual and may continue for up to two years of treatment. AZA side effects include malignancy, leukopenia, thrombocytopenia, nausea, vomiting and hepatotoxicity.³

Cyclosporine A inhibits calcineurin. The mechanism blocks helper T-cell synthesis of interleukin-2 and prevents helper T-cell dependent function. It is mainly used when patients are intolerant of AZA or corticosteroids. Side effects include hypertension, renal failure, hirsutism, gingival hyperplasia, gastrointestinal disturbance, flu-like symptoms, paresthesias, myalgia and headache.³

Other long-term immune suppressive agents used in the treatment of MG include mycophenolate mofetil (used to prevent transplant rejection), cyclophosphamide, rituximab, tacrolimus, methotrexate and etanercept. All of these agents have been successfully used as second-line agents to treat MG. With all immunosuppressive agents, side effects must be monitored closely and the cost-benefit ratio must be weighed.³

Short-Term Immunosuppressive Agents

Plasmapheresis and intravenous immunoglobulin therapy (IVIg) have rapid onset and lead to improvement within days, but effects are transient. They are used in situations of severe exacerbations of MG, myasthenic crisis and before surgical procedures. They can also be used intermittently in patients whose disease is not well-controlled despite chronic immunomodulating therapies.³ Plasmapheresis works by removing AchR antibodies from circulation. One exchange is done every other day, four to six times.³

The mechanism of IVIg on the autoimmune response is complex. It acts by suppressing antibody production and the immunoreactivity of autoantibodies via anti-idiotypic antibodies. In addition, it inhibits complement activation and the formation of membrane attack complexes.¹⁶ Other mechanisms include preventing the binding of Fc receptors on macrophages, Ig receptors on B-cells, and antigen recognition by T-cells.¹⁷ Plasmapheresis has been shown to be equally effective for exacerbations of MG, but IVIg is better tolerated by patients and thus used more frequently.¹⁰

Surgical Treatment

Thymectomy was the first immunomodulating treatment used in MG. It became a generally accepted treatment

for generalized MG in the 1940s and 1950s. Approximately 85% of MG patients have thymic abnormalities, including hyperplasia and thymomas. Surgical thymectomies have shown therapeutic effect, but the benefit is controversial. Stable remission has been reported in the range of 15-64%.⁹ Wide variability is likely due to differing surgical techniques. The benefits are sometimes delayed months to years after surgery.¹³

Myasthenic Crisis

Presentation of myasthenia gravis is a non-emergent referral with one exception: signs of dyspnea or dysphagia. Weaknesses to bulbar (speech, chewing, swallowing) muscles and respiratory muscles, including the diaphragm, produce symptoms that define myasthenic crisis. Myasthenic crisis requires immediate referral to the emergency room for prevention of respiratory arrest and ultimately death. Close observation, intubation and feeding support may be instituted. In addition to supportive therapy, the focus of action may be reducing circulating antibodies with plasmapheresis, or administration of autoimmune modifying drugs, such as corticosteroids and intravenous immunoglobulin. While corticosteroid treatment is initiated, patients must be closely observed due to the risk of acute worsening of weakness.¹⁸

Approximately 15-20% of patients with generalized MG experience myasthenic crisis at some point during the course of the disease. Current statistics report a 3-8% mortality rate from MG. Seventy percent of myasthenic crisis cases are provoked by concurrent infections or fever that include the upper and lower respiratory tracts. Other risk factors include certain medications and surgical interventions. The remaining patients present in crisis because of inadequate control or delayed diagnosis and treatment of the disease.¹⁸

Ocular Management

Ocular management of MG is focused on relief of symptoms. The most elementary technique to relieve variable diplopia is teaching patients the use of head turn. Through the use of a head turn, the patient can find a position of gaze where fusion can be appreciated.

Occlusion therapy may be indicated

for persistent or non-tolerable diplopia. Occlusion patching or high-plus contact lenses can be used. When orbicularis oculi weakness is exhibited, incomplete blinking causing exposure keratopathy can be observed. This is usually successfully treated with topical lubrication. In extreme cases, eyelid taping may be used. Due to the fluctuation of the ophthalmoplegia, no prism is indicated in the setting of MG.

Surgical treatment options are mainly for symptomatic relief of persistent ptosis. They include ptosis repair surgery, blepharoplasty, frontalis suspension, external levator advancement and tarsomyectomy. Other non-surgical options to treat ptosis are botulinum toxin type A injections and the use of a ptosis crutch. The ptosis crutch is made of Teflon or plastic and is mounted onto a spectacle frame to pull back the eyelids. Topical lubrication may also be needed if eyelid taping or ptosis crutch is used due to the risk of exposure keratopathy.¹

Medications that may Exacerbate Myasthenia Gravis

Many medications have been implicated in either inducing or worsening myasthenia gravis. The reasons for the exacerbation are likely multifactorial and may or may not be solely related to the medication. These medications include aminoglycosides, telithromycin, neuromuscular blocking agents, magnesium sulfate, beta blockers and many antibiotic therapies.³ The Myasthenia Gravis Foundation has a report for healthcare professions on "Medications and Myasthenia Gravis," which can be found at: <http://www.myasthenia.org/HealthProfessionals/EducationalMaterials.aspx>. If a MG patient needs an oral medication for management of an unrelated ocular condition, a consultation with the patient's co-managing neurologist is warranted prior to initiation of treatment.

Conclusion

With diplopia and ptosis being the most common presenting symptoms of myasthenia gravis, optometrists may be the first to encounter an undiagnosed patient. The cases presented here demonstrate classic signs of purely ocular (case 1) and generalized myasthenia gravis with ocular involvement (case 2). Recognition of bulbar and respiratory

signs and symptoms require emergent referral to prevent respiratory failure and ensuing death. These teaching cases exemplify the importance of optometric in-office history skills, diagnostic testing and clinical decision-making for effectively diagnosing and managing emergent and non-emergent cases of myasthenia gravis. Thorough history, prompt diagnosis, and referral may be life-saving for patients with myasthenia gravis.

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Optometry Students' Exposure to and Perspectives on Pharmaceutical Industry Gifts and Interactions

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Abstract

Relationships between doctors of optometry and the pharmaceutical industry have the potential to create conflicts of interest. The purpose of this study was to evaluate optometry students' exposure to and perspectives on doctor-industry relationships. The results of an online survey showed that optometry students have substantial exposure to industry through meals, educational gifts, and sponsored trips. Perceptions differed among students regarding the appropriateness and influence of gifts. Students overwhelmingly believed that faculty members are immune to the influence of industry gifts and reported that their prescribing habits mirrored that of their faculty members. The results of this study have important implications for optometric educators.

Key Words: Pharmaceutical industry, conflict of interest, optometry students

Background

Over the past few decades, the relationships between physicians and the pharmaceutical industry have attracted increasing scrutiny by educational institutions,¹ lawmakers,² and the media³⁻⁷ due to concerns about conflict of interest. Physicians and industry must maintain a working relationship, but doctors are often unsure how to legally and ethically navigate these relationships. In 2012, the pharmaceutical industry spent more than \$27 billion on the promotion of pharmaceutical products in the United States.⁸ Some educational institutions have enacted stringent policies to limit or ban pharmaceutical industry interaction, receiving recognition from the American Medical Student Association (AMSA) in its PharmFree initiative.¹ In March 2010, lawmakers passed the Physician Payments Sunshine Act as part of the Affordable Care Act to increase the transparency of financial relationships between doctors and industry.⁹ A clearer understanding of exposure to and attitudes about industry relationships is essential in identifying areas for reform and monitoring the effects of policy and cultural shifts.

The influence of industry in medicine is ubiquitous.¹⁰⁻¹² In a 2007 study, 94% of physicians reported a relationship with a pharmaceutical company in which they received some type of gift, such as food or drug samples.¹³ Previous studies have also shown that increased exposure to industry representatives and branded items leads to more favorable opinions toward accepting gifts and generates positive feelings about the company's products.^{10,12,14} This interaction between doctors and the pharmaceutical industry is initiated early in training¹⁵ or even prior to medical school.¹⁶ Pharmaceutical sales representatives offer gifts such as textbooks, anatomical models, or drug references.^{17,18} Doctors and students are invited to continuing education lectures that offer free meals while industry-paid speakers lecture on the use of particular drugs and devices.^{10,19} Students are honored with scholarships and travel grants from industry and select students are chosen to attend all-expenses-paid destination conferences.¹⁹

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Several studies have provided convincing evidence that interactions with pharmaceutical representatives influence the prescribing habits of physicians.²⁰⁻²³ Pharmaceutical company visits are associated with an increase in medication prescriptions,²⁴ and physicians who rely on information provided by pharmaceutical sales representatives often have a higher prescribing cost than physicians with less industry interaction.²⁰ These interactions also influence which drugs physicians request to add to hospital drug formularies.²¹ All-expenses-paid trips to attend pharmaceutical company educational programs in popular vacation locations appear to be particularly influential.²³ In a study by Orlowski and Wateska,²³ prescriptions of the sponsor's products increased significantly after a sponsored event, even though the majority of physicians who attended believed that such enticements would not alter their prescribing patterns.

Medication samples are another important marketing technique used by pharmaceutical companies and have also been shown to influence prescribing.²⁵⁻²⁹ Samples of newer, often more costly, pharmaceuticals are distributed to doctors for patients or personal use.^{29,30} The availability of samples during medical training can have a significant influence on forming the malleable prescribing practices of students and residents.^{26,31} Like gifts, drug samples are an important factor to be cognizant of when considering the influences of the doctor-industry relationship.

The philosophy of doctors regarding industry interaction is often formed early in their medical education.^{17,32,33} Students in professional programs may feel a sense of entitlement due to the financial hardship of student loans and the rigors of classes and clinical training.^{17,34,35} This sense of entitlement leaves students susceptible to the allure of free meals and other niceties from pharmaceutical companies who are seeking to shape the prescribing habits of these soon-to-be doctors.

Many doctors and students believe they are above the influence of drug company incentives and are offended by the suggestion that they could be bought, although they acknowledge the influence on others. In one survey of medi-

cal students, 84% of respondents felt that gifts influenced their peers but only 39% agreed that their prescribing habits were likely influenced as well.³³ Another study found that 85% of medical students believed it was improper for politicians to accept gifts; however, only 46% believed it was improper for medical students to do the same.³⁶ Even among students who declared the acceptance of gifts and meals to be unethical, almost all admitted to accepting these favors when they were offered.³³ This shows a common disconnect between attitudes and behavior.

In addition to studies focusing on medical students, other studies have explored the influence of industry in other healthcare professions such as dentistry,³⁷ pharmacy,³⁸ and nursing.³⁹ To the authors' knowledge this is the first study to focus on the relationships between industry and the profession of optometry, specifically optometry students. Optometry students face many of the same ethical dilemmas as medical and other healthcare students, but optometry students struggle with some unique challenges as well. Optometry, by its very nature, focuses on the prescription of spectacles and contact lenses, both of which are marketable products. Practice management courses in optometry school focus on making a profit and running a successful business, but typically only address the ethics of industry relationships in passing or not at all. Learning more about the attitudes of optometry students toward industry and the factors that shape these attitudes will allow a deeper understanding of how to better prepare students to manage industry relationships.

Methods

The Institutional Review Board at Midwestern University approved this study. An anonymous 30-item online questionnaire was utilized to survey fourth-year students at all schools and colleges of optometry in the United States. (**Appendix A**) Fourth-year students were studied because it was expected they would have the most exposure to pharmaceutical industry interaction and that they would have broader clinical experience having trained at external rotations sites. Approval was requested from the Dean, or the equivalent there-

of, at schools and colleges of optometry in the United States. Upon receiving permission, a website link to the online survey was distributed to fourth-year students via an e-mail from the Dean. Participation was voluntary and all questions were optional.

Survey responses were collected during January and February of 2013. This time frame was chosen for distribution of the survey as it was after the second session of the National Board exams and prior to the months approaching graduation. A better response rate was anticipated during these months.

The survey contained four sections: 1) demographic information including school, age, and sex, 2) exposure to the pharmaceutical industry, 3) attitudes about the influence of pharmaceutical company interaction and gifts, the appropriateness of various gifts, and pharmaceutical company motivation, and 4) adequacy of curriculum related to the topic.

To evaluate exposure, students were asked to report how many industry-sponsored events (dinners, receptions, lectures, etc.) they had attended in the past year and if they had received airfare or hotel accommodations to attend an industry-sponsored educational conference. To quantify gifts, students were asked the number of pieces of equipment (occluder, penlight, near card, drug guide, etc.) they currently owned with a pharmaceutical company logo. The topic of white coat sponsorship by a pharmaceutical or device company was also included to further determine exposure. In addition, students were questioned about the use of pharmaceutical samples in their clinical settings.

The next section of the survey evaluated attitudes of students regarding industry gifts and interaction. To evaluate beliefs about the influence of gifts and samples, respondents were queried about whether their prescribing habits would be influenced by gifts or samples. They were also asked to estimate what percentage of their colleagues would be influenced by gifts or samples. Students responded to three items investigating whether they believed the monetary or educational value affected the appropriateness of accepting the gift. Five items

evaluated the perceived motivation of drug companies. The survey also asked whether or not the respondents believed patients were aware that doctors accept gifts from drug companies.

Seven items were included to investigate faculty and curricular effects on exposure and attitudes. Regarding industry-sponsored events, the survey inquired if a faculty member had recommended or required attendance. Students were asked if they believed lecture content or prescribing habits of faculty were influenced by gifts and how likely they were to prescribe a medication that their attending faculty prescribed. Lastly, students were asked to describe the amount of instruction they had received regarding doctor-industry relationships and if they felt their school should provide more education on the topic.

Results

Study population

The overall response was 67 students from 10 schools and colleges of optometry. Response rates among schools varied. Student ages ranged from 24 to 33 years with a mean of 26.8. Forty-five respondents (67%) were female and 22 respondents (32%) were male. The proportion of women and men in the study sample is similar to the national proportion for optometry students in 2013 (64.5% women).⁴⁰

Exposure

All students who responded to the survey had received gifts from a pharmaceutical or device company or attended industry-sponsored events. Ninety-five percent of students had attended at least one industry-sponsored event in the previous year. **Figure 1** shows the number of industry-sponsored events attended by respondents within the previous year. About half of respondents (47%) reported that a faculty member recommended or required attendance at an industry-sponsored event. Ninety-two percent of students had received at least one item of equipment from a pharmaceutical company. **Figure 2** quantifies the number of optometric-related gifts reported by students. Of respondents, 53% had received airfare or hotel accommodations to attend an industry-sponsored conference. Stu-

Figure 1
Number of Industry-Sponsored Events Attended by Optometry Students

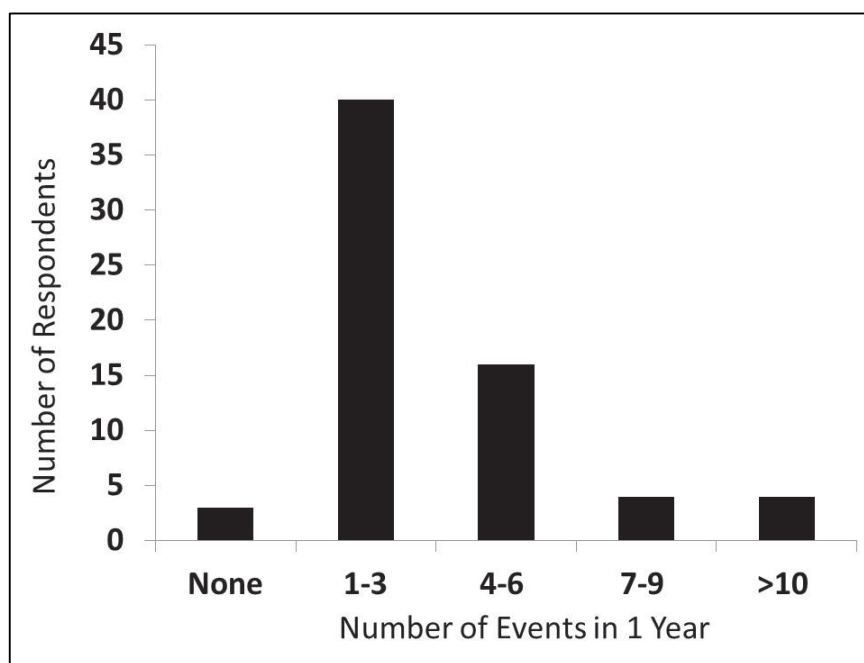
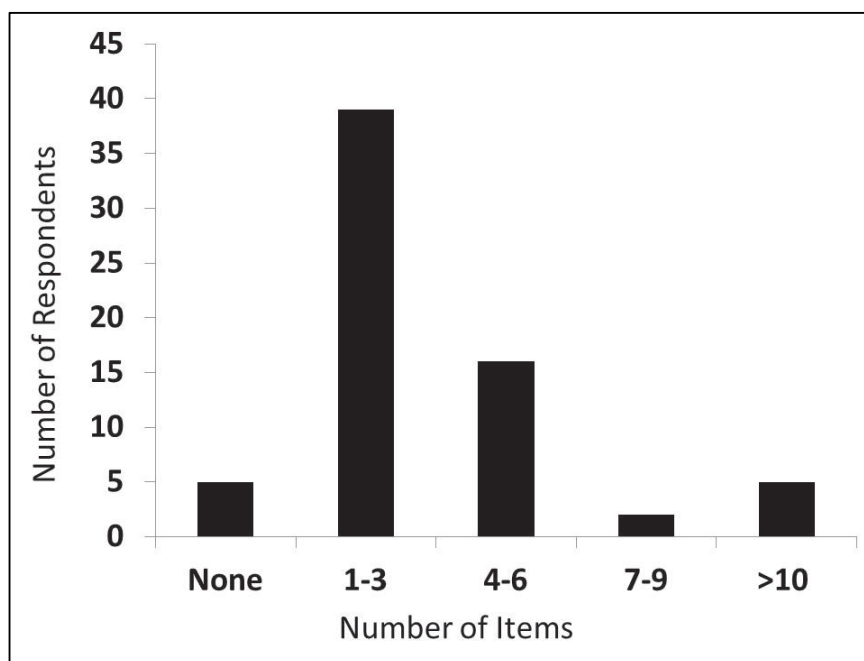


Figure 2
Number of Pieces of Student Optometric Equipment Gifted from a Pharmaceutical Company



dents from four of 10 schools reported an industry logo on their white coat.

The survey inquired whether prescription or over-the-counter medication samples were used at the students' academic institution. In some cases,

students from the same institution gave differing responses regarding their school's usage of drug samples. This suggests a level of unawareness on the part of some students regarding the use of samples. Seventy-seven percent were

aware of the use of both over-the-counter and prescription samples at their institution. Only two respondents reported that their school did not use samples of any kind, but this information was refuted by multiple respondents from the same two institutions.

Perspectives

Regarding beliefs about the effects of gifts, 75% of respondents said that gifts from drug companies would not influence which products they prescribe. When asked if their colleagues would be influenced by gifts, 18% responded that only a minority of optometrists (<10%) are influenced, 37% responded that approximately a quarter of optometrists are influenced, and 44% responded that at least half of optometrists are influenced by industry gifts. Ninety-four percent replied that they are more likely to eventually prescribe a medication if they have a sample, and 92.5% believed that at least half of optometrists would change their prescribing based on the availability of samples.

Students had differing beliefs about the guidelines that determine the acceptance of gifts. One such guideline bases acceptability on value, specifically the monetary value. The student responses are shown in **Figure 3**. Fourteen students (21%) responded that no gifts are acceptable, while 16 (24%) responded that gifts of any value are acceptable. The remaining 54% felt that the appropriateness of a gift was dependent on its monetary value, with more expensive gifts being deemed less appropriate. Seventy-three percent responded that accepting cash from a drug company is less appropriate than accepting a dinner of equal value. Furthermore, 75% percent of students felt it was more appropriate to accept a gift with an educational value, such as an eye model or drug reference guide, than a non-educational gift like a meal or trip.

Perspectives on drug company marketing and motivation are shown in **Figure 4**. Almost unanimously (98.5%), the students surveyed believed that speakers at continuing education events should be required to disclose sponsorship. Most students disagreed (79%) that drug companies were the best source for information about new products. Many students reported

Figure 3
Monetary Value at which Industry Gifts were Deemed Acceptable by Students

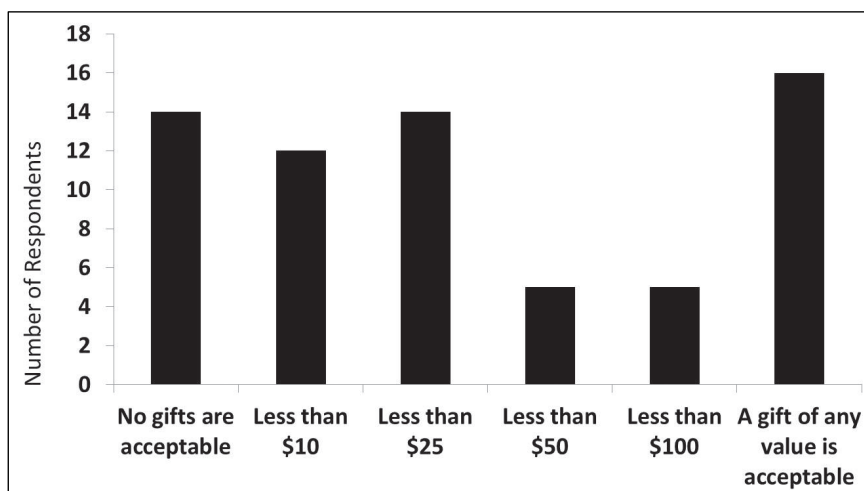
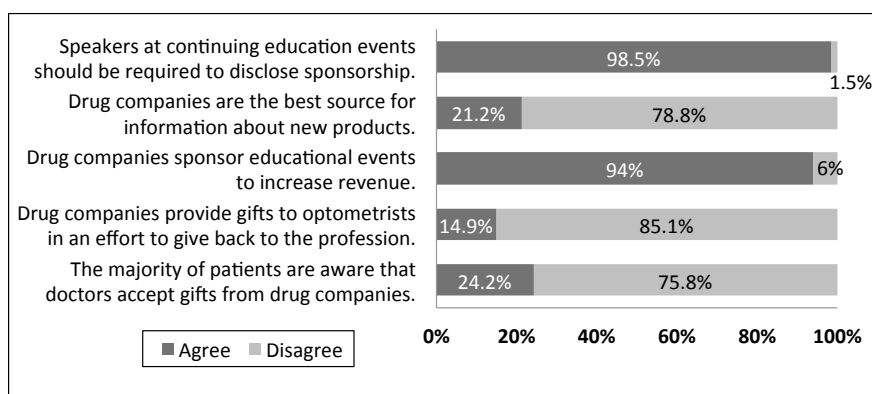


Figure 4
Optometry Students' Perspectives on Drug Company Marketing



skepticism about drug company motivation. Ninety-four percent agreed that drug companies sponsor educational events to increase revenue and only 15% agreed with the sentiment that drug companies provide gifts to optometrists to give back to the profession. Only 24% of respondents thought patients were aware that doctors accept gifts from drug companies.

Education

Students reported that they are more likely to utilize a drug prescribed by a faculty member (90%), and that receiving gifts does not influence what fac-

ulty members teach in lecture (93%) or prescribe in clinic (72%). Regarding curricular education on the topic, 36% of respondents had received no formal instruction on doctor-industry relationships, 48% had received 1-2 hours and 16% had received 3 or more hours. Sixty-six percent felt they had a good understanding of the ethical considerations in dealing with doctor-industry relationships, yet 85% responded that schools should provide more instruction about how to deal with situations that may present potential conflicts of interest due to doctor-industry relationships.

Discussion

This study adds to the literature on doctor-industry relationships by examining exposure and attitudes of optometry students. Optometry students face the same ethical dilemmas related to industry gifts and interaction as students in other healthcare professions.

Comparable to studies of medical students,¹⁰ this study showed that optometry students have substantial exposure to the pharmaceutical industry. A study of 164 primary care residents found that 97% carried at least one item with a pharmaceutical logo in their white coat and approximately half of items that residents carried were from pharmaceutical companies.¹⁸ Similarly, in this study 92% of optometry students had received at least one item of equipment from a pharmaceutical company. These gifts are permissible within the ethical guidelines of the American Medical Association (AMA) as they benefit the patient and are of non-substantial value⁴¹; however, branded equipment could be viewed as free promotion and patients may assume product endorsement by their doctor. In the same study of primary care residents, when asked if they would consider wearing a patch on the chest pocket of their white coat advertising a product if the company offered to pay them money, 13% responded affirmatively.¹⁸ Industry sponsorship of white coats in optometry school is not uncommon, as students from four of 10 optometry schools represented in this study reported an industry logo on their white coat, albeit in a more inconspicuous location. This could be considered a type of branding and may send an unintended message to both students and patients. It is yet to be seen if enactment of the Physician Payments Sunshine Act will significantly affect student and physician exposure.

Perspectives on the appropriateness of accepting industry gifts and other doctor-industry interaction varied among the students participating in the survey. In agreement with previous studies,^{10,15,17,42} optometry students were more accepting of inexpensive, small gifts and those with an educational purpose than expensive or non-educational gifts. In a survey of internal medicine faculty and residents, 23% of faculty members and 15% of residents believed

that doctors could not be influenced regardless of the value of the gift received.⁴² In this study 24% of students responded that gifts were acceptable regardless of the monetary value.

Students and physicians alike tend to deny that gifts influence their prescribing habits, yet most feel their colleagues are susceptible to these same influences.^{16,20,33} Chren et al. discuss the “phenomenon of gift giving” and the cultural significance of gifts.⁴³ Acceptance of a gift, regardless of monetary value, creates a relationship between the giver and recipient and generates a sense of obligation to reciprocate. It would be improper for doctors to give a gift in return to a pharmaceutical company representative, but they might reciprocate consciously or subconsciously in other ways.

Attitudes about the use of pharmaceutical samples are conflicting. Some of the purported benefits of samples include the ability to initiate treatment immediately, ability to evaluate effectiveness and adverse side-effects prior to patient purchase, and reduced cost for uninsured patients. The downside is that physicians might prescribe a drug based on the availability of a sample over an equally effective and more economical alternative.^{25,27} Morelli and Koenigsberg²⁹ found that when a prescription was written at the same time that a sample was dispensed, it was almost always for the same brand name medication. In this study, 94% of students said they were more likely to prescribe a medication if they had a sample. A study by Miller et al.²⁸ found that physicians were three times more likely to prescribe a generic medication when samples were prohibited. The authors concluded that although physicians may believe they are saving their patients money by offering a free sample, these giveaways likely lead to higher costs for patients and society in the long run as physicians tend to prescribe the same, more expensive medication. Faculty modeling of this “sample-based prescribing” may negate teaching of evidence-based prescribing.

Doctors of optometry, particularly clinical academic faculty, should consider that the mere *perception* of influence may have powerful effects. A previous study found that among medical residents 47% believed that income or gifts

from industry sources influenced how attending physicians taught in rounds, and 58% believed it would influence lecture material.⁴⁴ In contrast, the majority of optometry students surveyed believed that faculty and attending doctors were immune to industry influences. In this study, 28% believed that industry gifts influence prescribing habits of faculty members, and only 7% believed gifts influence lecture content. According to the American College of Physicians, “Gifts, hospitality or subsidies offered to physicians by the pharmaceutical industry ought not to be accepted if acceptance might influence or appear to others to influence the objectivity of clinical judgment.”⁴⁵ Even if a faculty member feels that accepting a gift, dispensing a sample, or lecturing on behalf of a company does not influence his or her clinical judgment, a *perceived* influence by students or patients may be just as detrimental.

The Council on Optometric Practitioner Education (COPE) currently requires disclosure of relevant financial relationships for continuing optometric education courses.⁴⁶ In this study, 98.5% of optometry students responded that speakers at continuing education events should be required to disclose sponsorship from drug companies. In a study of medical residents, three out of four desired disclosure of all financial relationships between their clinical teachers and industry.⁴⁴ This raises the question of whether financial disclosures should be required of faculty lectures that are part of the didactic education in optometry school and whether clinical instructors who are prescribing pharmaceuticals and medical devices should also reveal financial relationships. Optometry students are at a very impressionable stage in their career, so perhaps this window of training is the optimal time to reinforce values of transparency and integrity. Full disclosure by faculty members would allow students to draw their own conclusions about potential bias and could reinforce the importance of independent thinking.

Instructional strategies that have been utilized in curricula addressing doctor-industry relationships include evidence-based literature review, facilitated discussion, mock simulations, independent readings, faculty debate, and

small group problem-based sessions. A 2008 review of formal curricula on the topic of pharmaceutical industry relationships conducted by Montague et al. found inconsistency in content, application, and methodology across programs.⁴⁷ In their review, it was reported that the impact of curricula on attitudes of medical residents was variable and modest.⁴⁷ To the authors' knowledge there has been only one study on the effect of curriculum regarding industry relationships on the attitudes of optometry students.⁴⁸ The AMSA has developed a "Model PharmFree Curriculum" that includes five core competencies, recommended strategies for teaching about conflict of interest, and additional resources.⁴⁹ Although developed for physician training programs, this guide is a good resource for all clinical medical professions and could be utilized by optometry students, faculty, and administrators interested in supplementing their curriculum on the topic. Further research on curricular content and its effects on attitudes, acceptance of gifts, and prescribing habits among optometry students and residents is warranted.

Frederic Hafferty writes about the hidden curriculum in medical education.⁵⁰ In addition to formal education on ethics, students form identities and philosophies based on the institutional culture and policies where they train and the role modeling of faculty. This education is not included in a syllabus or tested on an exam, but rather observed in clinical settings, informal conversations, and social events. Doctor-industry relationships in an academic setting have greater significance when considered in the context of role modeling. In this study, about half of students had been asked or required by a faculty member to attend an industry-sponsored event. Industry sponsorship of white coats, a symbol of professionalism, also sends a covert message. The impact of the hidden curriculum should not be discounted. The material presented in lecture halls should be reinforced by the behavior of faculty members in order for students to internalize it. Faculty modeling and institutional culture may in some cases contradict policies or ethics education, making it difficult for students to navigate the murky waters of industry interaction.

There were several limitations to this study. The first major limitation of the study is the small sample population. The study was distributed only once at participating colleges and there was no follow-up to encourage participation of non-respondents. The limited sample population creates the potential for bias of respondents. Students who chose to participate may have had greater interest in or stronger opinions on the topic of industry relationships than students who did not respond. The sample was, however, representative of the optometry student population and included participants from ten schools. Responses were not evaluated by college due to sample size; however, future studies could investigate how institutional policies on pharmaceutical interactions affect exposure and attitudes of optometry students.

Another limitation of the study is the cross-sectional design. Questions related to exposure are susceptible to inaccurate recall, and questions pertaining to perspectives may be influenced by social desirability bias. Additionally, the cross-sectional design evaluates opinions at one point in time and does not consider how attitudes may change from pre-clinical through clinical training. The study did not evaluate if increased exposure or education was correlated with positivity or skepticism. The results of this study do suggest the influence of faculty role modeling. Future studies might investigate faculty exposure to industry and prescribing behavior in relation to student attitudes and behavior.

Conclusion

In conclusion, this study complements the previous literature on industry relationships in healthcare education. The results of this study have important implications for optometric educators. In addition to adding or increasing curriculum hours allotted for the topic of doctor-industry conflicts of interest, faculty and administration at colleges of optometry should consider the hidden curriculum. Recommending attendance at industry lectures, prescribing medicines based on availability of samples, and soliciting sponsorship of white coats likely sends a stronger message than a formal lecture on the ethics of industry relationships. Following the

path of the AMSA and medical education, it is time to consider the culture of pharmaceutical interaction in optometry education and determine the best practices to legally and ethically navigate these relationships.

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Appendix A: Online Survey of Fourth-Year Students

1. **If you do not wish to participate in the research study, please decline participation by clicking on the “dis-agree” button.**
Agree
Disagree
2. **Which school do you attend?**
ILLINOIS COLLEGE OF OPTOMETRY
INDIANA UNIVERSITY
INTER AMERICAN UNIVERSITY OF PUERTO RICO
MASSACHUSETTS COLLEGE OF PHARMACY AND HEALTH SCIENCES
MICHIGAN COLLEGE OF OPTOMETRY AT FERRIS STATE UNIVERSITY
MIDWESTERN UNIVERSITY - ARIZONA COLLEGE OF OPTOMETRY
NEW ENGLAND COLLEGE OF OPTOMETRY
NORTHEASTERN STATE UNIVERSITY - OKLAHOMA COLLEGE OF OPTOMETRY
NOVA SOUTHEASTERN UNIVERSITY
THE OHIO STATE UNIVERSITY
PACIFIC UNIVERSITY
PENNSYLVANIA COLLEGE OF OPTOMETRY AT SALUS UNIVERSITY
SOUTHERN CALIFORNIA COLLEGE OF OPTOMETRY
SOUTHERN COLLEGE OF OPTOMETRY
STATE UNIVERSITY OF NEW YORK
UNIVERSITY OF ALABAMA AT BIRMINGHAM
UNIVERSITY OF CALIFORNIA – BERKELEY
UNIVERSITY OF MISSOURI AT ST. LOUIS
UNIVERSITY OF HOUSTON
UNIVERSITY OF THE INCARNATE WORD
WESTERN UNIVERSITY OF HEALTH SCIENCES
3. **Please select your gender.**
Female Male
4. **What is your age?**
5. **How many industry-sponsored events (dinners, receptions, lectures, etc.) have you attended in the past year?**
None 1-3 events 4-6 events 7-9 events >10 events
6. **A faculty member has recommended or required that I attend an industry-sponsored event.**
Agree Disagree
7. **How many pieces of your optometric equipment have a pharmaceutical company or product logo? (occluder, penlight, near card, drug guide, etc.)**
None 1-3 items 4-6 items 7-9 items >10 items
8. **Have you received airfare or hotel accommodations to attend an industry-sponsored educational conference?**
Yes No
9. **Is your white coat sponsored by a pharmaceutical or contact lens company? (Is there any logo other than that of your school's anywhere on your coat?)**
Yes No
10. **Which of the following best describes how your school uses samples?**
My school does not use samples of any kind
Over-the-counter samples are available but no prescription drug samples
Both OTC and prescription medications are available
11. **Do you feel that gifts from drug companies (meals, gifts, educational materials, etc.) will affect which products you prescribe?**
Yes No

-
12. Approximately what percent of your fellow optometry students do you think would be influenced by gifts from drug companies?
<10 % ~25% ~50% ~75% >90%
13. Are you more likely to eventually prescribe a medication if you have a sample of it?
Yes No
14. Approximately what percent of optometrists do you think are more likely to prescribe a medication if they have a sample of it?
<10% ~25% ~50% ~75% >90%
15. It is OK to accept gifts as long as the value is less than:
No gifts are acceptable Less than \$10 Less than \$25 Less than \$50
Less than \$100 A gift of any value is acceptable
16. It is more acceptable to accept a gift with an educational value such as an eye model or drug reference guide than a non-educational gift like a meal or trip.
Agree Disagree
17. Accepting \$50 in cash from a drug company is less appropriate than accepting a steak dinner which is worth \$50.
Agree Disagree
18. It is OK to accept gifts as long as you accept them from all companies so you are not biased.
Agree Disagree
19. Drug companies provide gifts to optometrists in an effort to “give back” to the profession.
Agree Disagree
20. Drug companies sponsor educational events to increase revenue.
Agree Disagree
21. Drug companies are the best source for information about new products.
Agree Disagree
22. Speakers at continuing education events should be required to disclose any sponsorship from drug companies.
Agree Disagree
23. The majority of patients are aware that doctors accept gifts from drug companies.
Agree Disagree
24. Receiving gifts influences what a faculty member teaches in lecture.
Agree Disagree
25. Receiving gifts influences what a faculty member prescribes in clinic.
Agree Disagree
26. I am more likely to prescribe the drugs my attending doctor prescribes.
Agree Disagree
27. How much instruction have you received regarding industry relationships?
None 1-2 hours 3-4 hours >4 hours
28. I feel I have a good understanding of the ethical considerations in dealing with physician-industry relationships.
Agree Disagree
29. Schools should provide more instruction about how to deal with potential conflict-of-interest situations.
Agree Disagree
30. Comments:
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