The Journal of the Association of Schools and Colleges of Optometry

OPTOMETRIC EDUCATION

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Association of Schools and Colleges of Optometry

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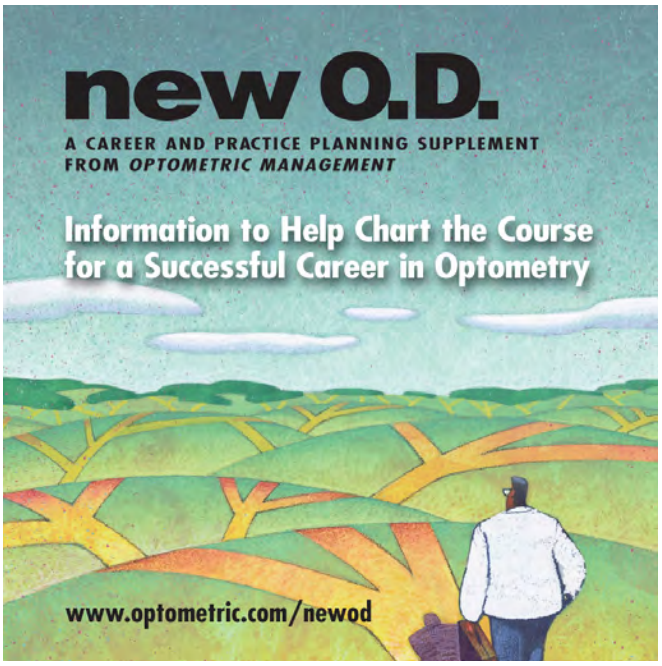

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SPECIAL REPORT

Attributes of Students Graduating from Schools and Colleges of Optometry

A 2011 Report from the Association of Schools and Colleges of Optometry

Accepted by the Board of Directors
October 11, 2011

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Doctors of Optometry

(American Optometric Association (AOA) definition)

Doctors of Optometry are independent primary health care providers who examine, diagnose, treat and manage diseases and disorders of the visual system, the eye and associated structures as well as diagnose related systemic conditions.

Introduction

In 2000, the optometric community jointly developed an initial statement of attributes expected of students graduating from schools and colleges of optometry. That effort resulted in "Attributes of Students Graduating from Schools and Colleges of Optometry: An Association of Schools and Colleges of Optometry Report," which was accepted by the ASCO Board of Directors on June 20, 2000. [Heath D, Daum K, DiStefano A, Haine C, Schwartz S. Attributes of students graduating from schools and colleges of optometry. Optom Educ. 2000 Fall;26(1):15-18.] This report provided a clearer understanding of entry-level competency and/or the competencies expected of students graduating from optometry degree programs in the United States.

To keep current, the Association of Schools and Colleges of Optometry periodically reviews and revises its policies. Accordingly, this 2011 revision of the Attributes Report represents contemporary thinking about the requisite competencies for new graduates of optometry programs, recognizing trends in contemporary health care education and health care delivery systems. Educational program management within optometry, as in all health care disciplines, is evolving with:

- improved descriptions of desired educational outcomes
- enhanced mechanisms assessing attainment of those outcomes on an individual student level as well as on a collective programmatic level
- expanding strategies that provide for ongoing scrutiny of individual and programmatic results while making appropriate adjustments to the outcomes as well as to the techniques used to teach/develop those outcomes.

This systems approach, which emphasizes the attainment of requisite competencies, is consistent with trends in medical education aimed at the achievement of best possible outcomes while also documenting those outcomes for a variety of internal (e.g., curricular managers, individual faculty teaching courses, administrators with overall institutional responsibility) and external (e.g., accreditors, trustees with fiduciary oversight responsibility, prospective students seeking educational value) groups seeking validation of the attainment of educational goals by the institution as a whole.

Notably, early accreditation efforts documenting the delivery of quality educational programs by the institution focused on time (e.g., clock hours in courses), content and the resources available for learning (e.g., appropriate credentials of faculty, square feet of class space, number of volumes in the library). More modern approaches to accreditation recognize that learning may take place in a variety of contexts that differ with respect to time devoted or resources used, and that, in fact, time and content are indirect and imperfect indicators of learning. Rather, health care education programs and their accreditors must focus on the student's (provider's) demonstration of competency for which attitudes, knowledge and skills are prerequisite.

Accordingly, current thinking reflects a concentration on results as well as confirming the presence of systems to appropriately monitor programs and students. This approach encourages adjustments based on assessments of outcomes.

"Attributes of Students Graduating from Schools and Colleges of Optometry" provides, as a national resource, a series of competency statements that broadly define the attributes expected of students graduating from any one of the schools or colleges of optometry in the United States. The faculty of each institution holds the responsibility to develop curriculum, and to assess and verify that each graduate has demonstrated the attributes described.

The attributes of students graduating from schools and colleges of optometry have been classified in three areas: Professional Values and Ethics, Knowledge and Skill. The faculty at each educational institution has a profound responsibility to develop, monitor and maintain a set of educational outcomes that:

- define specific educational outcomes for each attribute
- include effective and comprehensive assessment methods that provide accurate and reliable data on the achievement of specific and related outcomes
- reflect a system of management that provides for ongoing, critical appraisal of educational programming with a commitment to revise the outcomes, resources devoted (time, faculty, teaching methodology) or assessment methodology to assure achievement of the goals of the program, even as the knowledge and the health care system evolves.

The important and valuable task of managing and/or evaluating the achievement of educational outcomes certifying that graduates of schools and colleges of optometry possess appropriate attributes to allow them to serve the needs of the public is

an ongoing and significant task. The members of the Association of Schools and Colleges of Optometry welcome this responsibility and remain fully engaged in this process.

Assumptions

The attributes expected of a new graduate reflect a body of knowledge, skills and professional attitudes at the start of a professional career. The knowledge, skills and attitudes that are appropriate at the point of entry into the practice of optometry are not defined in isolation; rather they are affected by many variables including, but not limited to, state laws, the nature of the educational process, the structure of the profession, health care policies, the economy and technology. What follows are the planning assumptions upon which the report "Attributes of Students Graduating from Schools and Colleges of Optometry" has been based. These may be classified into two broad categories: 1) the nature of the Doctor of Optometry as a health care provider, and 2) the nature of the educational and professional environments.

The nature of the Doctor of Optometry as a health care provider

Doctors of Optometry are:

- expected to manage every relevant condition in a manner that assures safe and effective care for the patient
- aware of their individual competencies and conduct themselves accordingly ("as taught")
- responsible for ongoing self-learning and for remaining current and competent in their knowledge and skills
- expected to utilize all resources, including ancillary personnel, intra- and inter-professional collaboration, co-management and referral in securing the best possible care for their patients
- expected to conduct themselves according to the profession as expressed in the Optometric Oath and AOA Code of Ethics
- expected to manage their practices in a manner that is appropriate within the health care delivery system and that promotes patient access to eye and vision care.

The nature of the educational and professional environments

- The central goal of Doctor of Optometry degree programs is to prepare students to enter into the general practice of optometry.
- The Doctor of Optometry will continue to be a post-baccalaureate degree program.
- Additional post-graduate education and training opportunities provide advanced practice skills and knowledge in specialized areas beyond those required for the general practice of optometry.
- The practice of optometry is regulated by State Boards of Optometry and requires an independent assessment of competencies prior to licensure.

The New Doctor of Optometry Must be Professional and Ethical

To serve the public and the profession well, new graduates must embrace and demonstrate the ethical and professional standards appropriate to being recognized as a health care provider. The new graduate must also recognize that the completion of the Doctor of Optometry degree program is only the first step in a life-long commitment to self-directed learning and continual professional improvement.

The school or college of optometry shall ensure that before graduation each student will have demonstrated critical professional and personal attributes, including the following.

Personal attributes:

- a commitment to life-long learning and providing the highest standard of care
- 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 ability to recognize personal limitations regarding optimal patient care and to work with the broader health care community in providing the best care possible.

Professional attributes:

- an understanding of professional ethics and challenges to the optometric profession posed by conflicts of interest inherent in health care delivery, and the ability to incorporate those principles into decisions affecting patient care, always keeping the patient's welfare foremost
- professionalism, by demonstrating honesty and integrity in all interactions with patients and their families, colleagues and others with whom the optometrist must engage in his/her professional life
- a respect for the dignity of every patient and a commitment to empathetic and confidential care
- a commitment to work as an integral member of the larger inter-professional health care team to improve patient care outcomes
- a commitment to be actively involved in organized optometry and the community.

The New Doctor of Optometry Must be Knowledgeable

To provide quality eye and vision care to their patients, graduating Doctors of Optometry must have an established knowledge of the basic and clinical sciences. The foundation must be broad and include the biological, medical, vision and optical sciences, as well as a basic understanding of the health care delivery system. The Doctor of Optometry must recognize the dynamic nature of knowledge and possess the commitment and skills needed to responsibly assess and apply new information and treatment strategies throughout his/her career.

The school or college of optometry shall ensure that before graduation each student will have demonstrated knowledge of:

- basic organ systems, with special emphasis on the ocular and visual system, and their inter-relationships to the body as a whole
- the cellular, molecular and genetic basis of the development, physiology, pathology and treatment of eye disease
- the structures and processes contributing to the development of refractive error and other optical and perceptual abnormalities of the visual system (This includes vision function with respect to deviation and enhancement such as, but not limited to, strabismus, amblyopia, oculomotor function, accommodation and visual perception.)
- the optics of the eye and ophthalmic lens systems (including spectacles, contact lenses and low vision devices) used to correct refractive, oculomotor and other vision disorders
- the various processes and causes that lead to dysfunction and disease, and the effect that these processes can have on the body and its major organ systems, with special emphasis on the ocular and visual systems
- mechanisms of action of the various classes of pharmaceutical agents, their interactions and their safe and effective use for the treatment of diseases and conditions affecting the eye and visual system
- vision therapy and other rehabilitative methods used for the management of common visual disorders
- the psychosocial dynamics of the doctor/patient relationship and understanding of the social, psychological and economic forces affecting diverse patient populations
- community health care resources and delivery systems to improve care
- practice management structures and strategies as they pertain to the various practice settings.

The New Doctor of Optometry Must be Capable

To provide the highest quality of care to their patients, Doctors of Optometry must possess appropriate cognitive and motor skills needed to prevent, diagnose, treat and manage clinical conditions that are within the scope of their professional responsibilities.

The school or college of optometry shall ensure that before graduation each student will have demonstrated:

- all the skills required for the diagnosis, triage, management and/or treatment of common visual conditions, including or resulting from:
  - refractive anomalies
  - abnormalities of accommodation, monocular or binocular vision skills, oculomotor and sensory/perceptual dysfunctions
  - ocular disease and trauma
  - prior ocular surgery and/or laser intervention
  - systemic disease
  - environmental or occupational conditions
- the ability to order and interpret frequently needed laboratory and diagnostic procedures
- 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
- the ability to prescribe or use ophthalmic materials, contact lenses, vision therapy, low vision devices, pharmaceuticals and certain surgical procedures to treat and manage vision disorders and disease
- an understanding of nutritional influences on ocular physiology and systemic health and disease
- the ability to understand, evaluate and apply the use of contemporary imaging technologies in the provision of eye and vision care
- the ability to recognize and initiate the coordination of patient care requiring advanced medical, systemic, inter-professional or specialty care
- the ability to recognize life-threatening conditions and to initiate immediate intervention
- effective communication skills, both oral and written, as appropriate for maximizing successful patient care outcomes
- the ability to appropriately use all resources, including the use of ancillary personnel, intra- and inter-professional collaboration, co-management and referral, in ensuring the best quality patient care
- the ability to access evidence-based knowledge (including through the use of information technology) and manage information, and to apply that information in making decisions about patient care and health care delivery
- the ability to embrace the cultural diversity and individual differences that characterize patients, populations and the health care team
- the ability to work in cooperation with those who receive care, those who provide care, and others who contribute to or support the delivery of prevention and health services.

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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Walmart Stores, Inc.

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Keeler Instruments
Transitions Optical
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Ophthonix, Inc.
Review of Optometry
Safilo Group
TLC Vision
Vision Source!

As of October 2011

Disposable Prism Covers Perform Reliably in Study

HAAG-STREIT USA

Based on the results of a study conducted in the Veterans Affairs Boston Healthcare System and published by the journal *Eye*, Haag-Streit's Tonosafe disposable tonometer prisms are a reliable alternative to the Goldmann Applanation Tonometer (GAT) for measuring intraocular pressure (IOP). [http://www.nature.com/eye/journal/v25/n5/full/eye201140a.html]

Tonosafe disposable prism covers are designed to replace the multi-use prisms created for the GAT. The study, which involved 652 eyes of 326 patients, is the largest to date comparing Tonosafe and GAT. In addition, it included eyes at the extremes of IOP, ranging from 3-34 mmHg.

Haag-Streit's single-use Tonosafe prisms.

Safilo Supplies Glasses For Special Olympians

Safilo GROUP

Safilo Group continued its support of Special Olympics as a sponsor at the 2011 World Summer Games, which were held in Athens, Greece, June 25 to July 4. The competition included 7,000 athletes from more than 170 countries.

As it has done since 2003, Safilo supplied prescription glasses and sunglasses to the athletes as part of the Special Olympics-Lions Clubs International Opening Eyes vision care program. Also, company personnel volunteered their time to help implement the events.

Opening Eyes was founded by the American Optometric Association's Sports Vision Section and formally incorporated into the Special Olympics Healthy Athletes program in 1997.

Safilo donated more than 80,000 optical frames and sunglasses between 2010 and 2011 for Special Olympics athletes.

Dr. Haine Partners with EMRlogic Systems

EMRlogic Systems has added Charles L. Haine, OD, MS, to its team of Subject Matter Experts. Dr. Haine recently retired from his positions as Professor and Associate Dean of Clinical Affairs at the Western University of Health Sciences College of Optometry. He will serve as Director of Connected Care, working primarily with James E. Grue, OD, Vice President of Clinical Outcomes and Connected Care.

EMRlogic has developed a knowledge-base-driven, rather than a traditional droplist-driven, approach to electronic health records. According to Alistair Jackson, the company's Vice President of Marketing and Business Development, Dr. Haine will help establish the new approach as a "must-see solution for institutions and businesses seeking to be the eyecare leaders in their respective fields and regions."

Two New Resources for Practices and Patients

Transitions

Two new resources are available from Transitions Optical, the EyeGlass Guide and the New Multicultural Consumer.

The EyeGlass Guide (EyeglassGuide.com) can be used online or in print. It details the benefits of various vision-optimizing lens options and allows consumers to build their ideal pair of eyeglasses, giving them an idea of what they need and want before their next appointment. The guide also reinforces the role of a qualified advisor in the eyeglass buying process, ultimately directing patients to an online eyecare professional locator. However, practices can use a version of the guide without the professional locator for their own outreach efforts if they prefer. A number of in-office and direct mail pieces promoting the guide are also available (Transitions-TOM.com).

The New Multicultural Consumer is a continuing education course. The 50-minute seminar, which is approved by the American Board of Opticianry, explains current research on spending mindsets and habits, changing media patterns, demographic shifts, the continued impact of acculturation and assimilation, and specific eyecare and eyewear perceptions for each of the three largest and fastest-growing demographic groups. The course can be downloaded through the Education section of Transitions.com/Pro and will soon be available to take for credit at Transitions.com/Education.

College Upgrade Includes Donated Fabrication Lab

essilor

The Michigan College of Optometry at Ferris State University has a new state-of-the-art facility, and its University Eye Center includes a new fully equipped optical fabrication lab that was donated by Essilor of America.The donated equipment, which consists of a tracer, blocker, edger, surfacer, polishers and refiners, will enhance the services provided to the community and give students hands-on experience with tools similar to those they will likely encounter in professional environments as they enter internships and the workforce.

In other news, Essilor International was recently named to Forbes magazine's list of "The World's Most Innovative Companies." Ranked 25th on the list, the company was recognized for its innovative eyeglass lens production and its impact on the optics industry.

Industry, Education Collaborate at Event

VISTAKON®
Division of Johnson & Johnson Vision Care, Inc.

Students, residents and faculty from the New England College of Optometry and the New England Eye Institute recently partnered with Vistakon, Division of Johnson & Johnson Vision Care, Inc., and its African-American Leadership Council to provide free vision evaluations at the National Urban League conference in Boston. Guided by residents and faculty, including Assistant Professor Bridget Hendricks, OD, MS, 32 second-year students performed visual acuity testing, retinoscopy, ophthalmoscopy and non-contact tonometry for 415 patients.

Patients also received educational materials and referral information. Additional sponsors were Optos and Marco, which provided instrumentation used in the evaluations.

Top row from left: Patsy Scott, Dr. Lee Ball, Dr. Giovanna Olivares, Dr. Colleen Riley, Eric Mitchell, Michael Sneed, Dionne Thorpe, Vincent Davis and Tom Roberts. Seated from left: Hiral Patel, Richa Garg, Rupal Bhagat, Dr. Bridget Hendricks, Suzanne McClain, Jennifer Le, Tiffany Cheng and Tara Roche.

Acculens Licenses Scleral Lens Designs

Acculens agreed to license its Maxim and Comfort SL branded scleral lens designs to Mediphacos. The agreement opens the Brazilian market to the Acculens scleral designs and allows for expansion into all of South America, Central America and Mexico.

Comfort SL is an alternative to soft lenses for the correction of non-distorted ametropic eyes. Maxim is indicated for the management of corneal distortion and dry eyes.

Harris Survey Queries Patients with Dry Eye

ALLERGAN

A survey of people who suffer from dry eye, which was commissioned by Allergan Inc., found that 48% of U.S. adults and 52% of U.S. women experience one or more symptoms of dry eye regularly.

Other findings include:

- 30% of men 55 and older and 19% of women 55 and older have experienced dry eye symptoms for more than 10 years.
- 19% of adults report using over-the-counter (OTC) eye drops to treat symptoms at least 5 times per week.
- 63% of adults who use OTC eye drops to manage their dry eye symptoms state the drops are only somewhat or not at all successful in managing their symptoms.
- Among the 41% of adults who visited an eyecare professional to treat their dry eye symptoms, 19% state they visited more than once before finding relief, and 22% state they still have not found relief.

The survey was conducted online from March 4-8 among 2,411 adults by Harris Interactive using its Quick Query omnibus tool. Figures for age, sex, race/ethnicity, education, region and household income were weighted where necessary to bring them into line with their actual proportions in the population. Propensity score weighting was used to adjust for respondents' propensity to be online.

New Automated Protocol for Low Vision Testing

M&S TECHNOLOGIES The First Choice in Vision Testing Systems

M&S Technologies released eLVT, a new methodology for low vision testing that was co-produced and engineered with Dr. Ian Bailey of UC Berkeley. The automated protocol is designed for accuracy and repeatability and to eliminate subjectivity, technician bias and varied interpretation of responses. The system can test at several distances and determine visual acuity thresholds to 20/20,000. Results can be printed and/or stored digitally.

The eLVT can operate with any Smart System product or be used as a stand-alone product for clinical trials and/or research and development.

Lens Corrects Astigmatism and Features HD Optics

BAUSCH + LOMB

New from Bausch + Lomb is the PureVision 2 for Astigmatism contact lens with High Definition Optics. High Definition Optics reduce spherical aberration in both the sphere and cylinder meridians to foster clear and crisp vision, especially in low light. The monthly replacement lenses feature optimized ballasting, a larger diameter and a large optic zone, all part of Auto-Align Design, to ensure stability. ComfortMoist Technology for overall comfort is also part of the lens design.

In other news, B+L added two people to the Boston Lab Channel team: Pat Murphy, Technical Services Manager, and Claire Venezia, Global Marketing Manager.

Gonio Lens Provides View, No Adjustment

VOLK® the leader in aspheric optics®

Volk Optical has designed a new gonioscopy lens to provide the most comprehensive sweeping views of the anterior segment. The G-6 Gonio has six closely aligned mirrors to provide a true 360-degree view during examination, with no lens adjustment required. The mirrors are equally angled, eliminating gaps for visualization of the entire anterior segment at 1.0X magnification. Doctors can quickly scan across mirrors without the confusion of tracking where one view ends and the next begins.

The G-6's taller, tapered profile is easier to hold within the orbit. Its no-flange design means there is no need to use a viscous coupling solution.

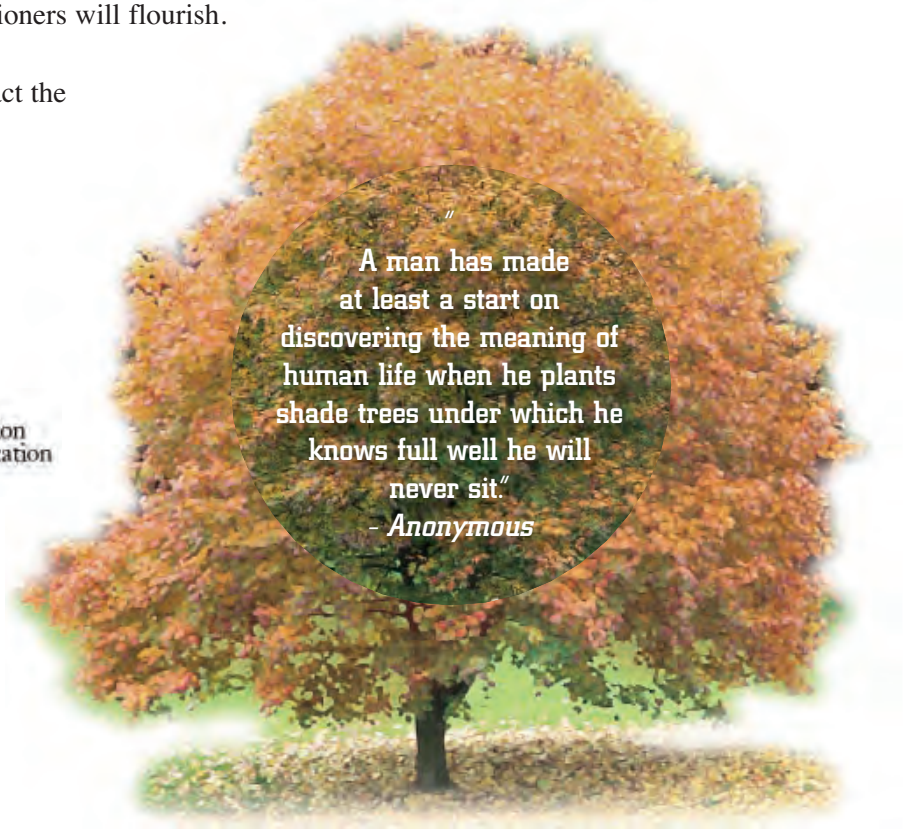
Have you thought about the future of Optometry?

We have!

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

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

Partnership Foundation for Optometric Education



EDITORIAL

Ethics vs. Values, Morals and Beliefs

Aurora Denial, OD, FAAO

Each September at optometry schools across the United States and Canada, new cohorts of students start their professional careers. The students appear enthusiastic and eager to acquire the information and skills needed to be a competent optometrist. Throughout the four years of optometric education, they will learn new terminology, knowledge and techniques. In addition, the more abstract skill set of ethics is identified as an outcome of optometric education.

In 2000, the Association of Schools and Colleges of Optometry (ASCO) identified specific entry-level competency skills and attributes that must be obtained before graduation with a doctorate degree in optometry.[1] The attributes, which were updated this year, appear in this edition of the journal. They include an understanding of professional ethics and standards and the ability to apply ethical principles in decision-making. Additionally, at commencement, optometry graduates recite the Optometric Oath, which states, "I will uphold and honorably promote by example and action the highest standards, ethics and ideals of my chosen profession and the honor of the degree, Doctor of Optometry, which has been granted me."[2]

What Exactly Are We Teaching?

If ethics is a required outcome of optometric education, schools and colleges must either teach the material or accurately screen for those attributes before admission. All optometry schools teach ethics in some format. Most educators recognize the ethical responsibilities of an optometrist toward patients, which require recognizing, respecting and protecting the rights of patients.[3] However, ethics as a concept can be challenging to define and teach. A Google search for "ethics" reveals more than 160 million possible Web sites. Most definitions contain some reference to the determination of right vs. wrong, correct or incorrect practices, the study and analysis of values and standards, etc. There is some debate among educators as to whether ethics can be taught to adult learners. This is based on the assumption that by adulthood, values, morals and beliefs are already set.

In this edition's installment of "Think Tank," a scenario that occurred during a fourth-year externship is described. The student in this scenario apparently lied in a report to the clinical instructor that if not corrected would have resulted in falsification of a legal document, the medical record. In addition, the student demonstrated no remorse or concern when confronted with the situation. The student's behavior and actions represented misguided and inappropriate values, morals and beliefs. Are a person's values, morals and beliefs innately part of ethics? Can these attributes be separated from the ethics we teach?

What are we actually teaching in courses on ethics? Are we teaching right from wrong or are we teaching something else? Obviously, course curriculum varies among institutions. Reflecting on my experience, teaching ethics involves understanding and dealing with opposing points of view, recognizing dilemmas and ethical principles, developing analytical and problem-solving skills, role modeling, understanding the meaning of professional obligation and responsibility, and coping with moral ambiguity. Dilemmas, generally defined as situations in which we must choose between two equally compelling or equally unsatisfactory alternatives, are often part of clinical practice and can impact patient care. Allowing students to discuss, debate and analyze cases or scenarios that have an ethical aspect is a valuable component of optometric education.

Students' Moral Compass

Ethics can and should be taught and modeled. A person's morals, values and beliefs are an intricate component of

being ethical and may or may not be modifiable in adulthood. I sense that most of our students want to do the "right thing" for their patients and welcome the opportunity to learn how to do so. Unfortunately, I also sense that a very small minority of students arrive with an apathetic moral compass and an even smaller minority with an inappropriate moral compass. How can educators distinguish between different groups of students and teach those who have an apathetic or inappropriate moral compass? How can educators distinguish ethics from morals, values and beliefs? These distinctions are important if we are to achieve the ASCO goals and deal appropriately with student behavior, such as what is described in "Think Tank."

Drs. Jeanette Sewell and Esther Han share with us their analysis of the "Think Tank" scenario in this edition, and we invite you to do the same. What is your evaluation of the situation? Was it handled properly? What are the challenges involved in dealing with this scenario? Does the faculty member have an obligation to discuss the case with the previous faculty member? What is the ethical responsibility of the clinical faculty and supervisor? Should the student's behavior have been reported to the student's school? Should the student have been allowed to continue in the externship program? Is the public safe in the student's hands? Are there protocols in place to handle such situations and if so what are they? Would a course in ethics help this student? How do you define ethics? Send your responses to Dr. Aurora Denial at deniala@neco.edu, and we will print them in the next edition of the journal.

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Thank you, Drs. Maino and Goodfellow

This edition of *Optometric Education* includes the final ASCOTech column by Drs. Dominick Maino and Geoffrey Goodfellow (page 19). As Editor of the journal, I would like to thank them for the time and effort they have put into their most informative and interesting articles on technology. Best wishes in the future.

Invitation to Participate
Upcoming Theme Edition

Scholarship

Scholarly contributions by faculty are a critical component of faculty development, promotion/tenure and delivery of optometric education. Most optometric faculty have minimal formal training in professional writing, research and publication. Scholarly contributions move education forward and can significantly impact the profession. *Optometric Education* is announcing a future theme edition, which will focus on scholarship. The theme edition is scheduled for publication in 2012. Deadline for submissions is Jan. 1, 2012. We invite all educators and administrators to participate**.**

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

Student's Behavior Raises Questions

Last year I supervised a fourth-year student during an externship at our facility. As is my custom, we reviewed past and current histories of the patient the student was about to examine. It was noted that the staff doctor who had seen the patient last had noted a nevus with "drusen-like" deposits in one of the eyes.

After the exam, the student returned to me to review the findings. The student made note of the nevus and stated that it contained "drusenoid" bodies. I asked the student to be more explicit in the description and diagnosis. The student offered no further information. When I asked the student to provide differential diagnoses, the student was unable to think of any. At this point we set out for the exam room so I could evaluate the patient.

Upon examination of the appropriate eye and location, I found no nevus or any other lesion. Thinking that the student might have described the wrong eye or location, I finished examining both eyes and found no lesions at all. Had I missed something? I asked the student to find the nevus so that I might evaluate it. The student could find nothing. It became clear at that moment that the student reported the lesion simply because it had been noted in the past, even though that notation had been erroneous.

After dismissing the patient, I reviewed what had happened with the student. First, I said I was quite disappointed on a personal basis because the student had lied to me. Second, I explained that clinical findings should always be based on what is actually observed; if the student had not seen the lesion, that should have been stated. Finally, I explained that if the student repeated this activity in practice, and it was discovered on audit, the student might be liable for perpetrating fraud and be subject to sanction, fine, prosecution and/or licensure consequences. Throughout this discourse, with an entirely blank face, the student said nothing.

Knowing this was not the first bad encounter our staff had had with this student, I felt it was proper to report the incident to my superior. Nothing more was said and no action was taken. The student finished the externship, graduated from school, received a license and was accepted into a residency program. I have been told the student has been overheard on numerous occasions telling other students what a terrible externship we have to offer. Apparently, this episode and perhaps others have had no positive effect on this individual.

Optometric Educators Respond

Jeanette M. Sewell, OD
Instructor of Record for Clinical Programs
Assistant Director of Residencies
New England College of Optometry

As noted in the description of the student's actions, falsifying records is fraud and carries significant sanctions for the licensed provider. Though the same sanctions are not applicable to a "student doctor," there should certainly be significant consequences. Colleges have clear policies regarding cheating on didactic exams and should have equally clear policies regarding cheating on clinical exams.

It is important for the school to know of any occurrence of unprofessional behavior because students rotate through multiple sites and only the academic institution would be able to identify repetitive behavior across different sites.

Students may not be able to correctly locate or identify every lesion, diagnose or manage every case, but they are capable of choosing honesty over dishonesty. That said, as clinical educators, have we given students the skills they need to be honest when choosing honesty means potentially admitting they are wrong? Have we introduced them to acceptable options when faced with clinical uncertainty or disparate exam findings? Have we taught them that the best clinicians are able to say "I don't know," "I need more information" or "I need another opinion"?

As clinical educators, we may not be comfortable dealing with what appears to be fraudulent behavior on the part of a student. It is unpleasant and (hopefully) unfamiliar to most of us. It also gives us the opportunity to teach alternative behaviors and approaches that will serve the student throughout his/her clinical career. However, this "teachable moment" does not mitigate the importance of having clear expectations, policies and consequences for such behavior, both in the individual clinical setting and in the academic institutions sponsoring the student doctors.

M.H. Esther Han, OD
Assistant Clinical Professor
SUNY College of Optometry

This case represents an ethical dilemma in optometric education that also exists in any health professional training program. So how and when do we begin to limit the number of individuals who exhibit unethical behaviors? Typically, organizations and policies change only in response to a very negative situation. In this case, it could be a highly publicized malpractice suit. How severe should the penalties be if one gets caught? Should there be a dismissal from a professional program? Should fines be imposed? Should one's clinical privileges or licensure be revoked or suspended? Who then enforces these policies and ensures that all schools of optometry are on the same page?

This issue can be addressed at many stages in the professional program. For instance, the professional admissions process can be more selective for candidates with high ethical standards. Early in the professional program, students can be presented with mock clinical situations in order to present them with the ideal ethical responses. The scenario described here occurred during the training process, which is the stage where there is not much accountability and where the interns are least likely to get "caught" by their supervisors. Those who are caught also do not experience any negative consequences for their actions as was seen here. This individual was able to continue to receive further clinical training in a residency program.

Often, practitioners begin to know each other or hear through word of mouth and get a sense of the ethical behaviors of their colleagues. In a self-selective process, optometry is a small profession and the names of these unethical practitioners will get around. But the question arises, should more be done before something serious happens that requires a change to the policies governing the ethical behaviors of our future optometric colleagues?

Send Us Your Comments

Do you have any thoughts or insights related to teaching ethics that you can share with the readers of Optometric Education*? What is your evaluation of the situation described here? Was it handled properly? What are the challenges involved? What are the ethical responsibilities of the parties involved? How do you define ethics?*

Send your responses to Dr. Aurora Denial at deniala@neco.edu, and we will print them in the next edition of the journal.

Educator, Preceptor, Researcher, Author and . . . Techno-Geek!

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

Back when dinosaurs roamed the earth and many of us were optometric youngsters, all the technology we required for teaching was an overhead projector, a slide projector, a piece of chalk and a chalkboard. At that point, we just needed a group of students in front of us who at least pretended to be awake for that 8 a.m. class. Students would often write furiously to gather the written and spoken words.

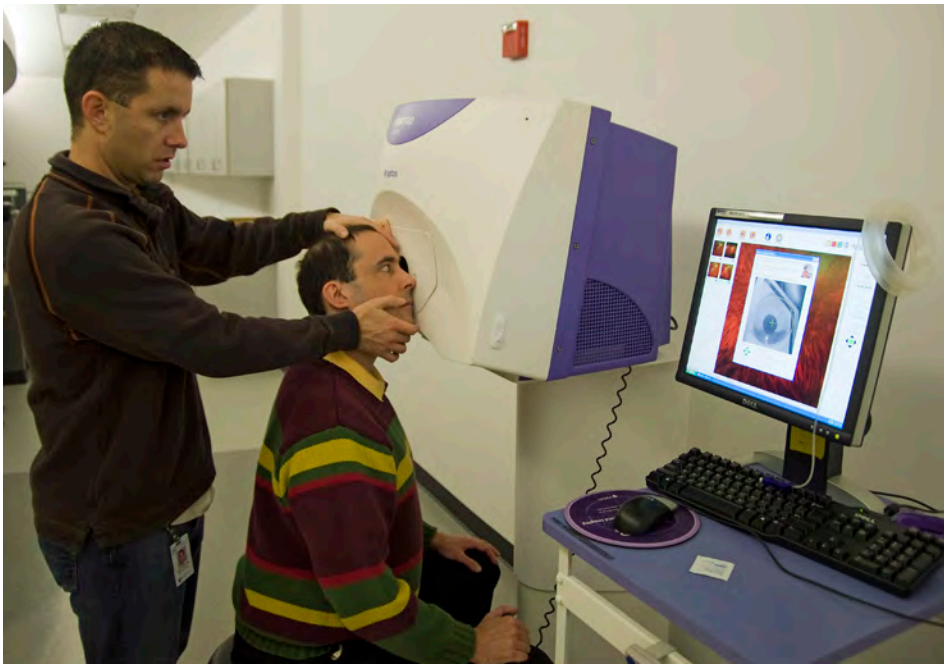
Today, it's a whole different story. Technology has made, and continues to make, its way into every aspect of teaching and learning. One of the consequences is that we as educators have some serious learning curves to climb. Not to mention that the time it takes (either on our own, with a group or online) to learn everything that is new has the potential to interfere with our ability to do research, develop lecture material, teach students in the classroom/laboratory/clinic, interact with patients and appropriately perform all the other responsibilities we have as optometric educators. Furthermore, we are expected to interact with students via e-mail, forum posts, chat rooms and various social media sites. No wonder we often feel overwhelmed.

On the other hand, new technologies allow students to interact and engage. They allow us to build digital bridges to students' minds to improve the educational experience. In addition, they can help us determine whether our students understand what is being taught. In the past few months, we at the Illinois College of Optometry (ICO) have undergone a whirlwind of digital transformations. Almost simultaneously, we not only remodeled our lecture center, but installed (and are in the process of tweaking) a host of cutting-edge technologies. This article provides an overview giving all some food for thought regarding both the challenges and the opportunities associated with technology in optometric education

Technology in the Clinical Procedures Lab: the EyePod

The EyePod is ICO's new clinical procedures laboratory. (**Figure 1**) We have installed computerized visual acuity

Figure 1
Learning to use patient care technology in ICO's EyePod.



Dr. Maino is a Professor of Pediatrics and Binocular Vision at the Illinois College of Optometry. Dr. Goodfellow is Assistant Dean for Curriculum and Assessment and an Associate Professor at the Illinois College of Optometry. You can contact them at dmaino@ico.edu and ggoodfel@ico.edu.

systems, electronic health records (NextGen) and digital eye health teaching devices. For example, the Eyesi Ophthalmoscope (VRmagic) is a training simulator for binocular indirect ophthalmoscopy. (**Figure 2**) The device can simulate patients with AMD, retinal detachments and other eye health problems. It can even determine whether our students actually saw that peripheral retinal hole.

The EyePod also includes digital video/audio recording capability that can be used during student proficiency evaluations for various diagnostic procedures and patient interactions. (The same computerized/digital enhancements are already used in the Illinois Eye Institute.) The digital recordings can then be played back at a later date so faculty and students can readily determine where students performed well and where they need to improve. The video can also be made available to students online so they can review it at their leisure.

Interesting videos or images shown at the teaching podium or gathered by the slit-lamp camera in the first lane are displayed on all monitors in the room.

Technology in the Lecture Center

The ICO lecture center has been completely remodeled so that students can digitally access what we teach via Wi-Fi or take notes that augment the presentation. (**Figures 3 and 4**) Each comfortable seat has its own table space and electrical outlet for plugging in laptop computers or other digital devices. In addition to high-resolution projectors for displaying our lectures, high-definition monitors are strategically placed for student and lecturer viewing. Cameras placed throughout the lecture center record presenters no matter where they may move about the stage area. This recording starts and ends automatically and then becomes immediately available to students right after the lecture for review from any Internet-accessible location. The recorded lectures show a video of the presenter and anything being shown on the data projector at that time. Live streaming of the lecture and optical character recognition of all PowerPoint slides are features still in the works. Imagine a student or faculty member being able to search the entire

Figure 2
Heather McLeod, OD, Assistant Professor at ICO, tests the Eyesi binocular indirect ophthalmoscopy simulation device.

Figure 3
The new technologically advanced lecture center.

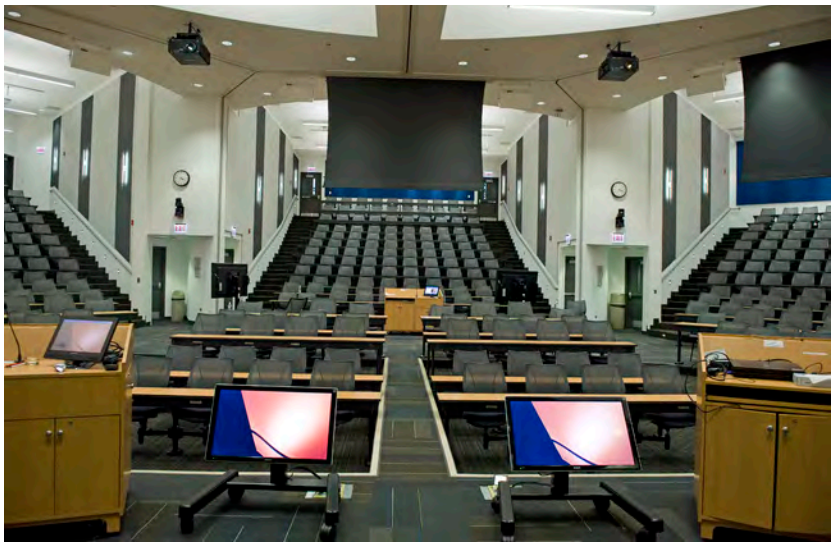


Figure 4
Richard S. Kattouf, OD, DOS, Chairman of the ICO Board of Trustees, speaks in the new lecture center.

catalog of lectures in the optometry program and find all occurrences of any keyword. With a mouse click, he or she could replay just those particular spots of the video recording.

During lectures, students and faculty can interact using the Turning Point Audience Response System. These clickers allow faculty members to pose questions via PowerPoint slides, retrieve answers from students, and display the results in a bar graph showing the number of students who selected each answer.

Student Information System

The College also converted to an entirely new Student Information System. Blackbaud, the global provider of software and services, integrates the activities of our admissions, registrar, business and development offices. Seamless sharing of information now allows data to be entered only once. The ICO Web page, applicant/student portal and faculty/staff portal also underwent a total overhaul with the introduction of My.ICO.edu, a Blackbaud interface that allows all of our digital resources to be available in one place. That's not all. An entirely new Learning Management System, powered by Sakai, has also been installed. Among its many functions, it gives students instant access to our PowerPoint presentations and lecture handouts.

Technology in the Exam Room

Just as with our teaching and laboratory spaces, our clinic areas have also become digital. Faculty and students use computerized visual acuity tools, visual field devices, non-contact tonometers and autorefractors/keratometers. We continue to work on improving our productivity with the new electronic health record system.

Our mission is to make all of this new technology work flawlessly while providing superior eye care to our patients and an exceptional teaching experience for our students. There's no doubt it demands a tremendous amount of effort for all of us. Strangely enough, when the digital gods shine upon us, we do manage to accomplish all we need to accomplish most of the time, and the march forward has benefited our students and educational programs in amazing ways.

A Farewell *from the Authors*

Dear Colleagues,

Sadly, this is the last installment of ASCOTech from the Amazing Digital Duo of Goodfellow and Maino.

You can continue to keep up with what we have to say about technology by befriending us on Facebook, linking to us on LinkedIn, tweeting us on Twitter, visiting MainosMemos.blogspot.com, contacting us the old-fashioned way, via e-mail, or reading our new column that will appear in the AOA News.

It certainly has been a pleasure writing this column for *Optometric Education* and for all of you over this past decade.

Thank you,

DM & GG

In Clinical Optometric Education, Does Extern Outreach Training Produce Outreach Providers?

Jacqueline G. Davis, OD, MPH, FAAO

Abstract

In an effort to determine if clinical optometric outreach training impacts the practice patterns of its graduates, survey responses were compared from graduates of an optometric college with mandatory senior clinical outreach externships (Group II) and graduates of the same institution prior to the implementation of outreach rotations (Group I). Group II donated more hours of benevolent optometric care per week compared to Group I. Group II reported higher levels of comfort and preparedness for community outreach work when compared to Group I. It is therefore concluded that outreach rotations do influence the practice patterns of their graduates.

Key Words: *outreach, underserved, uninsured, practice patterns, clinical healthcare education, health disparities*

Dr. Davis is an Assistant Professor of Clinical Optometry at The Ohio State University College of Optometry. She teaches anterior ocular pathology to second-year students and is Clinic Chief of an outreach optometric clinic in an underserved area of Columbus, Ohio. Previously, she owned a private practice for 22 years.

Background

Community outreach and engagement are missions established by many healthcare educational institutions across our nation. Outreach services involve provisions given to groups in society who might otherwise be neglected. Training students to become effective providers in underserved communities is a goal with significant potential public health benefits. These potential assets, however, never become realities if the graduates do not go on to provide outreach services in their own professional careers.

Currently, an estimated 46.3 million individuals living in the United States have no health coverage.[1] Many of these individuals have access to minimal to no preventive healthcare interventions, which leads to a reliance on emergency rooms and healthcare safety-net programs for episodic healthcare concerns. This lack of continuity of care tends to result in less than optimal health behaviors as well as exponentially higher overall healthcare costs.[2]

With the passage of the 2010 healthcare reform bill, the Affordable Care Act, 32 million of the currently uninsured Americans will soon become eligible for healthcare coverage.[3] The long-term uninsured population will bring with it unique health challenges that will require in-tune health professionals to effectively address its issues.

Despite the enlarging umbrella of insurance coverage, the nonpartisan Congressional Budget Office estimates that 23 million people will remain uninsured by the year 2019. Seven million will be undocumented immigrants and 16 million will be individuals who are not required or chose not to purchase insurance as well as those who believe they cannot afford to purchase insurance.[4] Therefore, the demand for healthcare providers who are prepared and willing to provide community outreach will be ongoing.

Historically, in urban and rural settings, the uninsured have benefited from healthcare providers who have been willing to provide donated services to those who could not afford to pay. Several studies in 2006 estimate that there

may have been more than $50 billion/year in uncompensated medical care provided in the United States that year.[5] This healthcare safety net relies on providers who are willing and are competent to deal with the health issues of the uninsured. As profit margins continue to narrow in the healthcare market, finding providers who are committed to community service is essential to keeping the volunteer network alive.

The Ohio State University, along with approximately 50 other state-supported universities was created as a result of the Congressional Land-Grant Act signed by Abraham Lincoln in 1862. Land-grant institutions were founded to be "the people's universities," encouraging extension of knowledge beyond the boundaries of campus walls. Over the years, the phrase "teaching, research and public service" has become synonymous with the missions of most land-grant universities.[6]

At The Ohio State University College of Optometry (TOSUCO), a mission of community outreach and engagement has been translated into efforts to educate optometric students who are prepared and willing to take on the challenges of optometric practice in all aspects of society. To that end, in 1995, TOSUCO instituted a Primary Care Externship program geared toward exposing senior optometry students to practice modalities away from the campus in private and group optometric practices. In 2001, that concept was expanded to include outreach facilities that incorporated various community-based optometric settings. These settings included homeless shelters, "house calls," mental hospitals, nursing homes, The Central Ohio Blind School and outreach clinics established in underserved communities.

The premise for incorporating the outreach element into the senior externship curriculum was threefold: 1) to enrich the students' clinical experiences, exposing them to more complex health issues and varied diagnoses; 2) to help the optometric students become more culturally competent, sensitive and aware of the diverse types of patients they may encounter in their future careers; and 3) exposing students to the benefits of community service allows them to witness the positive impact they can make on the overall health of a community and gives them the opportunity to experience the "good feelings" that can be associated with involvement in benevolent activities.

The purpose of this investigation was to attempt to determine if the second and third objectives were met and to determine if outreach education influences the level of delivered outreach care. The following questions were the basis of this study:

- Do the graduates of TOSUCO who have been exposed to the clinical outreach programs implemented in 2001(Group II) go on to provide outreach care?
- Is there a difference in the outreach delivery rates after graduation between those who rotated through the outreach rotations (Group II) and those who did not (Group I)?
- Is there a difference between the graduates' perceptions of their clinical education in the realm of understanding health disparities and the needs of the underserved?

Methods

A literature search was completed to determine if any previous studies had been done on this topic. Although there were no studies specifically comparing outreach exposure vs. no outreach exposure, several medical and dental school retrospective studies investigated potential predictive factors influencing graduate practice decision-making.[7-9] Several questions asked in these studies were incorporated into the instrument developed for this investigation.

The questions asked in the survey were developed through consultation with various current and previous members of the faculty at TOSUCO. Most notably, the current and previous Extern Coordinators at the College gave insight into the history of the program and the rationale behind the expansion of the outreach component.

A total of 734 questionnaires were mailed to TOSUCO graduates between the years of 1995 and 2006 (1995-2000 n=365 surveys; 2001-2006 n=369 surveys). No pilot pre-testing was done. Stamped return envelops were included with each questionnaire. The instrument used was designed to gather the desired information with a minimum amount of time and effort required of the alumni being polled. Because of The Ohio State University Institutional Review Board's requirement of respondent anonymity, the survey was mailed only once. Re-mailing of the instrument to nonresponders would have required knowledge of the identity of the initial responders.

Demographic information was collected through survey questions related to the sex and ethnicity of the doctor, year of graduation, type of practice modality and percent time spent in the various practice types.

Ten outreach questions were asked using a five-level Likert response scale. Three questions asked for approximate percentage levels of patients seen with no insurance, Medicaid and Medicare. One question requested the number of hours per week donated to underserved populations. (**Appendix 1**)

Likert responses of Strongly Agree and Mostly Agree were recorded as positive responses. Strongly Disagree and Mostly Disagree responses were tallied as negative responses. Unpaired two-sample T-tests were performed to determine whether differences existed between the two groups of alumni.

Results

A total of 309 questionnaires were returned resulting in a return rate of 42.1%. Five questionnaires that were returned were missing pertinent data such as date of graduation, which rendered them unusable. There were 145 usable surveys from alumni who graduated in the years of 1995-2000 (70 females and 75 males) (Group I) and 159 usable questionnaires from the group of graduates from the years of 2001-2006 (80 females and 79 males) (Group II).

About 80% of doctors with outreach externship experience expressed that they felt well-prepared to deal with patients from different socioeconomic backgrounds compared to about 67% of those without outreach externship

training. (p=0.013) (**Figure 1**). When it came to working with patients from different ethnic/racial backgrounds, 79.5% of those with outreach experience felt prepared compared to 61% of those without the outreach training (p=0.0002) (**Figure 2**). Group II alumni responded positively to their preparation to work with disabled patients at a rate of 70.5% compared to 49.3% from Group I (p=0.0001) (**Figure 3**).

Group I alumni were more likely to respond negatively when asked if their education had made them aware of healthcare disparities. Almost 23% of the earlier graduates' responses indicated that they felt that their education did not make them aware of existing disparities in health care for individuals in underserved populations compared to 12.6% of the later graduates (p=0.00005) (**Figure 4**).

There was no significant difference between the positive or negative responses of the two groups in the questions related to the practice of treating patients from diverse backgrounds. Both groups perceived themselves equally as positive influences in their communities (p=0.844). There was also no significant difference between the percentages of Medicaid (p=0.164) or Medicare (p=0.68) patients in the practices of either group. The two groups were virtually equal in their responses to the question about their desire to provide care

Figure 1
"My optometric education prepared me well to treat patients from different socioeconomic backgrounds."

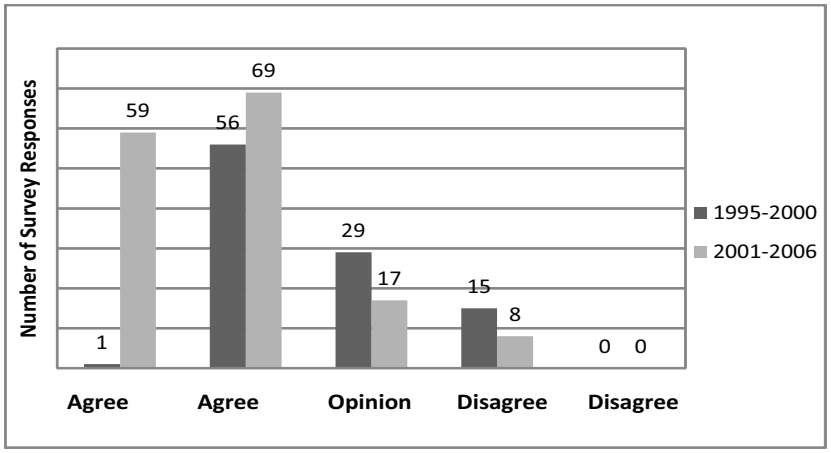


Figure 2
"My optometric education prepared me well to treat patients from different ethnic/racial backgrounds."

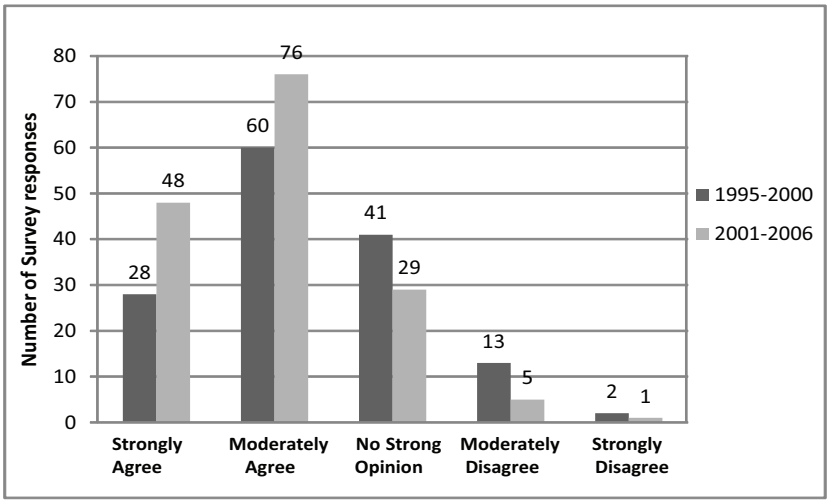


Figure 3
"My optometric education prepared me well to treat patients with disabilities."

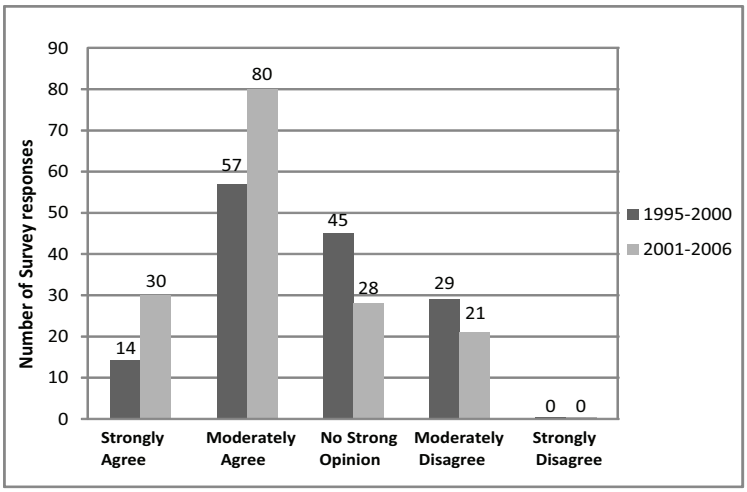
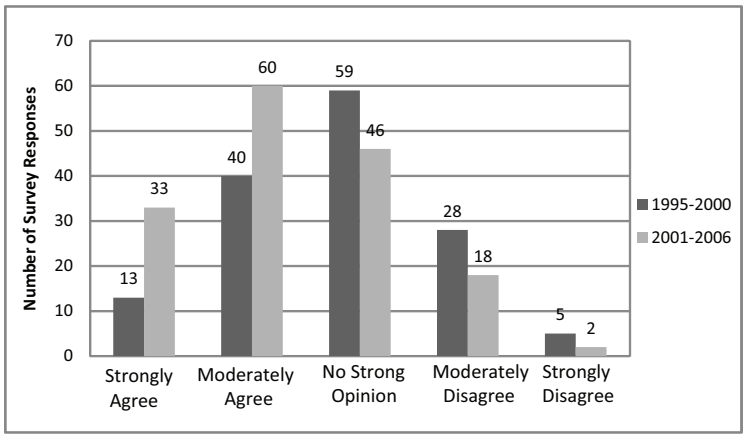


Figure 4
"My optometric education made me aware of existing disparities in health care for individuals in underserved populations."



to the underserved while in optometry school (p=0.242) (**Figure 5**).

The only significant differences in practice modalities were found in the number of doctors practicing in corporate and residency settings (**Figure 6**). Older graduates reported higher levels of corporate work compared to their younger counterparts (p=0.0002). The newer graduates were exclusively involved in residency programs.

The question "What approximate % of your patients has no vision or health insurance?" was determined to be flawed because respondents interpreted it in more than one way. Some respondents interpreted the question to mean that the patients are indigent and cannot afford vision or health insurance. On the other hand, several doctors added comments on this question, indicating that they do not accept any type of vision or health insurance in their practice, which would require all of their patients to pay cash for their services. Because of these two opposing interpretations, the results from this question were not included in this analysis.

The level of donated care given per week was higher for outreach-trained doctors compared to those without the outreach experience. Group II reported a mean of 3.0 hours per week compared to Group I's mean of 1.55 hours per week (p=0.04) (**Figure 7**). The range of donated care for Group I extended from 0-14 hours per week, while Group II's donated care ranged from 0-45 hours per week.

Conclusions

TOSUCO outreach extern rotations appear to have been successful in influencing the graduates' perceptions of their outreach readiness. Alumni who completed the outreach rotations indicated that their optometric education had prepared them to be comfortable and confident providing care to patients from diverse socioeconomic, ethnic/racial and disability backgrounds and to understand the complexities of health disparities.

Group II graduates were very positive about the quality of their optometric education in the realm of the treatment of special populations. They were aware of health disparities, and they felt they

Figure 5

"During my optometric education, I had a strong desire to provide vision care to underserved individuals."

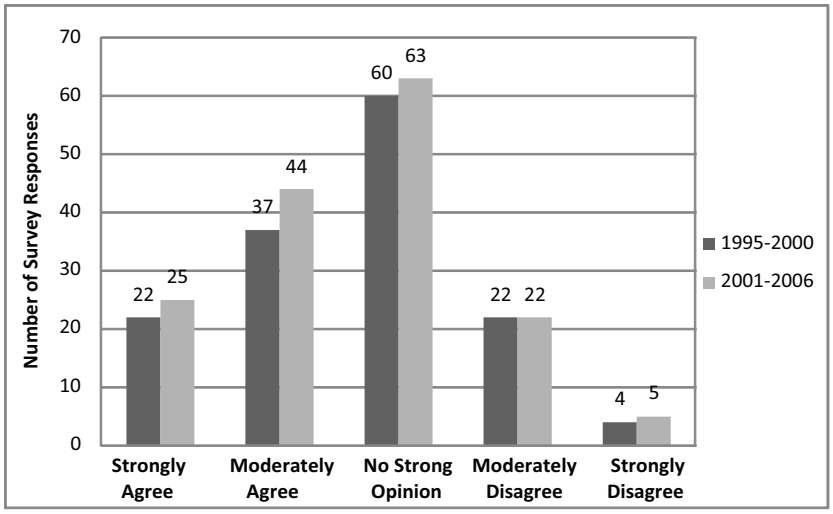


Figure 6

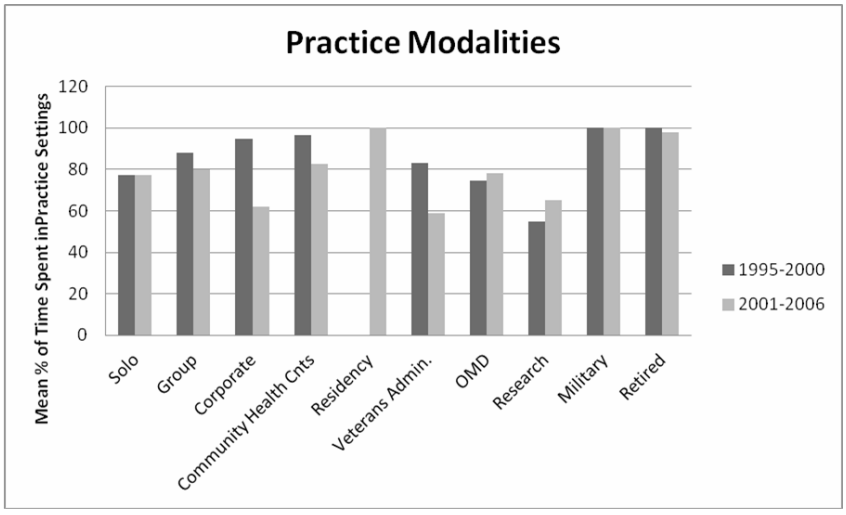
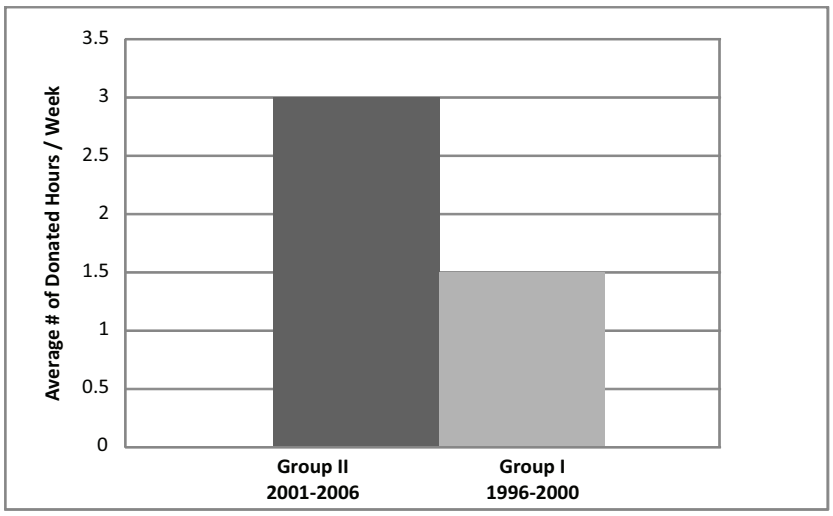


Figure 7

"How many patient care hours do you donate to underserved populations per week?"



had received sufficient guidance in addressing the issues of those special populations.

At the same time, Group I graduates relayed negative responses regarding perceived deficiencies in their optometric education in the area of health disparities. They felt they had not received an appropriate amount of instruction on this topic.

It was found that the TOSUCO outreach program did influence the benevolent practice patterns of its graduates. Survey respondents reported an average of 1.55 donated hours per week for Group I and 3.0 hours per week for Group II. Using a metric of 30 minutes per patient per examination time, this could be extrapolated to suggest that outreach-trained doctors donated care to 156 more underserved patients per year than nonoutreach trained doctors.

This argument is strengthened by the fact that there was no significant difference between the groups when questioned about their desire to provide care to the underserved while they were in optometry school. Therefore, if they began with equal levels of interests in community care, something in their education likely fostered the difference between the groups. It is quite possible that the outreach experiences gained during the senior year encouraged graduates to provide benevolent care as they began their careers and made them more comfortable in doing so. It is possible that there were other factors that may have augmented the differences between the two alumni groups. There may have been didactic coursework added into the curriculum that supplemented the issues addressed by the clinical outreach efforts. No such curriculum additions have been documented, but classroom discussions are not always thoroughly reflected in course outlines. It is also possible that generational and societal influences may have affected their practice decisions.

It is important to note that there are limitations to the ability to generalize the results of this study. The nonrespondents to this survey may have had very different responses from those who did complete and return this instrument. Nonrespondents may have had a more neutral or negative opinion of the value of the education received at TOSUCO.

It is probable that economics is another strong factor influencing the level of donated care offered by optometric practitioners. Despite the fact that many new graduates have significant levels of indebtedness in the forms of professional school loan repayments, they may not have established other large financial commitments such as home mortgages, practice purchase loans, equipment leases and children's school tuitions during their early post-graduation years. The doctors in the 1995-2000 group may be experiencing some or all of those pressures.

It is also possible that newer graduates have more free time in their work schedules, which they are able to fill with donated care. This variable was not pursued by this study, but it is a factor that warrants further investigation. If length of time in practice is a strong confounding variable, it would be expected that the number of hours donated would decrease the longer an alumni was in practice, but that was not the case for either group (**Figure 8**).

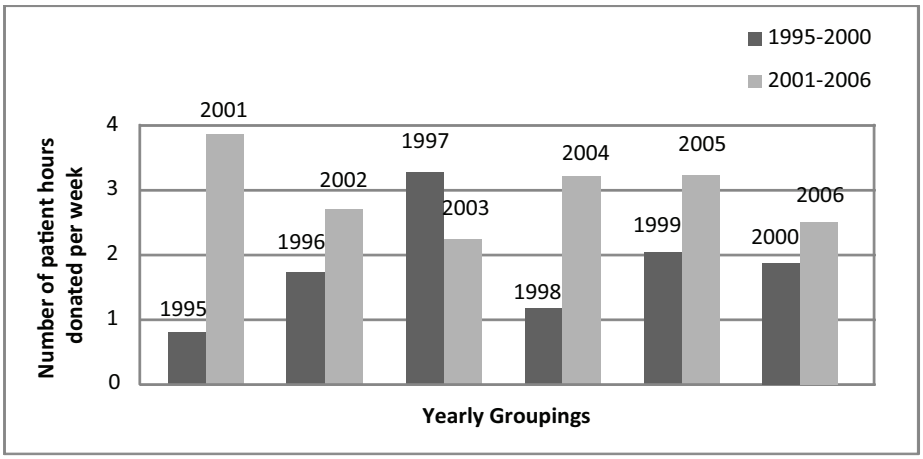
Despite the difference in the outreach training of the two groups, both groups were very positive about the fact that they do treat patients from diverse walks of life. Seventy-four percent of the responses from both groups were either Strongly Agree or Moderately Agree on this inquiry. This reflects quite positively upon the graduates as a whole in their desire to provide care to a variety of patient groups. This finding is in line with the American Optometric Association's 2006 Scope of Practice Survey in which 73.7% of respondents reported that they donated some of their time and talents to local charitable organizations.[10] This demonstrates that optometrists as a group tend to be civic-minded professionals who are willing to offer help to those in need.

It should be noted that donated care is not the only way an optometrist can provide community service. Acceptance of low-reimbursing state and federal insurance plans can be of tremendous benefit to low-income communities. Involvement in public health education programs, screenings and charitable contributions to healthcare agencies are all valid avenues of community health promotion.

This study has found that rotations through optometric outreach externship programs do foster the awareness for the need for civic responsibility. This heightened awareness appears to translate into practitioners who do go on to provide outreach care in their communities.

Figure 8

"How many patient care hours do you donate to underserved populations per week?"



As the current tough economic climate continues to foster uninsured or underinsured families, optometric educational institutions should be preparing their graduates to address such public health shortcomings. This study suggests that implementing or expanding optometric clinical outreach curriculum is worthy of investigation.

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Appendix 1

The following fourteen questions were asked. The same five-level Likert response scale was used for the first ten questions.

1. My optometric education prepared me well to treat patients from different socioeconomic backgrounds.

1	2	3	4	5
Strongly Agree	Moderately Agree	No Strong Opinion	Moderately Disagree	Strongly Disagree

2. My optometric education prepared me well to treat patients from different ethnic/racial groups.
3. My optometric education prepared me well to treat patients with disabilities.
4. My optometric education made me aware of existing disparities in health care for individuals in underserved populations.
5. During my optometric education, I had a strong desire to provide vision care to underserved individuals.
6. Currently, I treat a diverse patient population.
7. Currently, I treat patients from all socioeconomic backgrounds.
8. Currently, I treat patients with disabilities.
9. Currently, I volunteer some of my services to underserved patients.
10. Currently, I make a positive influence on public issues in my community.
11. What approximate % of your patients has no vision or health insurance? _____%
12. What approximate % of your patients has a type of Medicaid insurance? _____%
13. What approximate % of your patients has Medicare insurance? _____%
14. How many patient care hours do you donate to underserved populations per week? _____%

Modernizing Optometric Education in Australia: Ideas from Medical Education

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Abstract

Little has changed in the delivery of optometric education in Australia for the past 40 years. In existing programs students undertake study in basic disciplines prior to gaining clinical exposure. This often occurs in university staff-student clinics, which are not necessarily representative of optometric practice in the wider community. Recently two new optometry programs have opened, both located within medical schools and comprehensive health faculties. This has enabled the new programs to benefit from some of the educational reforms in Australian medical education, including outcomes-based design, early and sustained clinical experience and use of student-centered learning models.

Key Words: *optometric education, competency-based education, case-based learning (CBL), team-based learning (TBL), outcomes-based education, backward curriculum design, clinical placements*

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Introduction: Why Change?

Optometric education in Australia, at least until recently, could be described as a small undertaking with less than 200 students per annum educated in three programs. Approximately four out of five graduates practice in the state in which they graduated[1], which may contribute to workforce shortages elsewhere, particularly in nonmetropolitan Australia[2,3].

The existing optometry programs focus on basic sciences such as biology in the early years with the subsequent introduction of applied sciences such as pharmacology. Clinical instruction and exposure generally occur deep into the curriculum. There have been recent changes of both structure and content to these programs. Changes in structure have included moving from four-or five-year undergraduate degrees to double degree combinations with science degrees as prerequisites for subsequent optometry qualifications. Content has been expanded to include prescription of therapeutic agents, a key development in Australian optometric practice.

Nevertheless, the profession of optometry itself is rapidly changing. It is becoming increasingly complex and more is required of practitioners than ever before. For instance, in Australia, optometrists are now expected to co-manage and prescribe therapeutic agents for patients who were previously referred to ophthalmologists, such as patients with open-angle glaucoma. This change in the scope of practice, combined with both the dramatic increase in the burden of chronic disease[4] and the nonmetropolitan undersupply of optometrists[2], provides compelling grounds for pedagogical and further content change. There is a need for pedagogies that will facilitate ongoing inquiry and lifelong learning and embrace new communication technologies. Indeed, technological advances, such as high-speed Internet and the facility to form networks of people in remote locations, offer much promise for training within these regions in-need[5]. In addition, as the vast majority of optometrists are either self-employed or practice owners[2], the consistent and formal delivery of courses for the commercial and managerial aspects of prac-

tice are long overdue.

There are two new programs in optometry in Australia. One began in 2011 and the other will take its first cohort of students in 2012. Significantly, the two new programs are located in medical schools that are, in turn, located within comprehensive faculties of health. This contrasts with the three existing programs, two of which are located in science faculties and the third in a health faculty without a medical school. In many ways, the practice of optometry reflects that of medicine. Optometrists contribute to the diagnosis and management of eye disease and ocular manifestations of systemic disease and as such optometry operates as an extension of medicine. In Australia optometry and general practice (family medicine) operate in similar settings and share the clinical paradigm of history → examination → investigations → impression → management. Indeed, optometry students must learn many things in common with those studying medicine.

The two new programs employ a Bachelor of Vision Science/Masters structure and have some similarities to two of the revised structures of the existing programs, one of which has a double bachelor degree structure and the other a bachelor/masters combination. The third existing program has just moved to a four-year graduate-entry doctorate.

The location of the two new programs in medical schools is significant. In Australia there has been a recent period of expansion and reform of pedagogy and content in medical education with the introduction of outcomes-based curriculum design, problem-based learning, early clinical experience in simulated and actual environments and substantial clinical placements in community and nonmetropolitan settings[6]. While some of these approaches are present in existing optometry programs, designers of the new programs were able to draw on their medical school colleagues to take a more holistic approach to incorporating the reforms in their curriculum design processes. The first author of this paper is an optometry and medical graduate and is head of one of the new programs. The second author has been associated with the two new programs and has long experience in medical education.

Table 1
Key Elements of the Proposed Framework for Optometric Education (in Australia)

1.	Begin with the end in mind - outcomes-based education
2.	Interprofessionalhealth practice, law and ethics, management and business acumen
3.	Early clinical exposure leading to extended clinical placements
4.	Case-based learning - facilitating student-centered inquiry
5.	Team-based learning

In light of this background this paper proposes a framework for the delivery of optometric education in Australia that is informed by the location of the two new programs in medical schools. The key elements are listed in **Table 1** and are discussed in the following sections of this paper.

Begin with the End in Mind: Outcomes-Based Education

The practice of optometry encompasses the assessment of the human eye and visual system as well as the management of patients with conditions of the eye and visual system. Optometrists in Australia do not currently provide surgical, laser or complex medical treatments as these are the remit of ophthalmology. Unlike those in the United States (U.S.), Australian optometrists cannot order general laboratory investigations to follow-up systemic conditions, such as blood tests for Lyme disease or sarcoidosis, nor can they order radiological investigations. However, optometrists in Australia do refer directly to ophthalmologists, as well as co-manage patients with ophthalmologists and general practitioners or family physicians.

As a vocation, optometry is unique. On a given day, Australian optometrists may perform primary visual assessments, treat advanced eye diseases and prescribe medicines and optical aids. As such, the profession shares traits with family physicians, ophthalmologists and pharmacists. At the same time, most optometrists are business owners and retailers, as approximately 80% of total revenues are generated through dispensing optical aids[7]. In Australia, optometry is regulated and is governed by a national registration board[8]. Optometric services are at present heavily subsidized by a federal Medicare scheme.

Unlike medical practitioners, who undertake several years of supervised postgraduate training, graduate optometrists in Australia are deemed fit for full registration and practice, and can do so, unsupervised and unmonitored from their first day of work. Only recently has continuing professional development become a requirement for ongoing registration[8]. The ever-increasing complexity, diversity and interprofessional commitments of optometrists in practice requires optometric educators to develop curricula that deliver the essential competencies required for modern optometric practice.

Competencies have been defined as the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection needed in daily practice[9]. In 1997, the Optometry Council of Australia and New Zealand (OCANZ) developed entry-level competencies[10,11] that must be demonstrated in the graduates of each school in order for its optometry program to be accredited. These include professional and clinical responsibilities, patient history, patient examination, diagnosis, patient management and recording of clinical data. Likewise, the U.S. National Academies of Science (Institute of Medicine) has recommended that all healthcare clinicians possess the following competencies: patient-centered care, ability to work in interdisciplinary teams, evidence-based practice, application of quality improvements, and the use of informatics[12]. Traditionally, regulatory bodies only specify clinical competencies. Given the contemporary roles of optometrists set out here, it is argued that if these competencies are to provide the underpinnings of optometric education, they need to be extended to include interprofessional and industry perspectives, ethics and law and retail,

management and commercial skills.

A fundamental assertion of this paper is to begin curriculum development with a comprehensive set of competenciesand, therefore, a vision of "the working optometrist." Critically, it is just as important to have an understanding of what "a working optometrist" is not, and thus subject matter that is not essentially related to clinical practice is avoided. Competencies can be equated to intended learning outcomes, which in turn form the basis of each pedagogical unit.

Outcomes-based education works from the principles of "backward design."[13,14] This is a multistage process for designing curricula and associated assessments. The first stage is to articulate the goals, in terms of knowledge, skills and behavior, that must be achieved by the end of each unit of study. As it pertains to optometric education, these are planned and distributed such that at the completion of the entire program graduates have achieved all of the competencies required to commence work as optometrists, including the additional competencies in interprofessional work, ethics and law and retail and management skills. The second step is to determine what is considered to be acceptable evidence of having achieved the goals for each unit of study, hence this step is intimately linked with assessment. The third and fourth steps in backward design are to plan the curriculum and the teaching and learning materials and experiences that will deliver the goals and standards.

Interprofessional Health Practice, Law and Ethics, Management and Business Acumen

Interprofessional health practice

More so than ever, optometrists are now integrated within the greater healthcare system. In Australia, optometrists can refer directly to, and co-manage with, tertiary medical specialists such as ophthalmologists as well as family physicians. Optometrists, for instance, manage patients with low vision. Thus an understanding of the role of occupational therapists and social workers is critical to effectively manage patients in a holistic fashion. Similarly, with the ever-increasing burden of chronic disease, such as type-2 diabetes[15], optometrists work closely with family physicians, endocrinologists, diabetes nurse educators and ophthalmologists to ensure the best outcomes for their patients. For the majority of private practitioners, this typically entails coordination of care through consultation and referral. For those working in hospital and community care settings, it may involve participation in multidisciplinary meetings. Therefore, graduate optometrists need to possess an understanding of the conventions for communication and interprofessional referral and work.

Interprofessional practice is a new concept in optometry education and needs to be reflected in the curriculum framework. Curricula should contain material that is common to any contemporary healthcare profession, including dimensions of interprofessional practice such as communication, health informatics, public health medicine and evidence-based medicine.

Law and ethics

Working as a health professional is a privilege that comes with great responsibility. While individuals seeking health services are seldom aware of the various regulations and codes of conduct, there remains a level of trust for health professionals that exceeds that for those in practically any other role. Health professionals handle issues and information that is, by definition, extremely sensitive, private and personal in nature. This is a serious undertaking so the process of becoming a health professional should be well-informed and deliberate, as opposed to passive and assumed. In the context of optometry education, it is critical that all students are educated on the meaning, behaviors and code of ethics associated with being health professionals[16].

Knowledge of the legal and ethical basis of optometry is as essential to clinical practice as knowledge of basic optometric sciences. The Optometry Board of Australia (OBA) requires that optometry graduates behave according to legal and ethical principles and must know about and comply with the OBA's Code of Conduct[8]. These standards can only be achieved when the teaching and learning of bioethics, law and professionalism are fundamental to, and thoroughly integrated both vertically and horizontally throughout, the curriculum as a shared obligation of all teachers[17]. This is where optometry educators can draw on the association of the two new programs with medical education in changing existing standalone courses in law and ethics to a more integrated approach.

Recently, the United Kingdom Institute of Medical Ethics (IME) issued an update to its 1998 consensus statement for the teaching and learning of medical ethics for doctors[18] in which it implored educators to take a unified and formalized approach to medical ethics education. A solid understanding of health and medical ethics and local optometric regulations facilitates reflective and critical thinking, from which flow benefits to both patients and practitioners. Indeed, the argument for such teaching and learning is supported by research demonstrating that exposure of medical students to medical ethics courses measurably improves moral reasoning[19], as well as confidence, communication skills and patient-centeredness[20]. Conversely, the potential disadvantages of not teaching ethics and the law are suggested by the findings in U.S. medical students of a strong association between unprofessional conduct and "burnout"[21] as well as future disciplinary action by medical boards[22].

Management and business acumen

Just under 70% of all optometrists practicing today in Australia are self-employed, owners of, or partners in the ownership of, their own practices[2]. Indeed, several business models, such as independent, franchise and consulting-only practice exist within the industry, for which the details and differences ought to be understood by all graduates.

Along with ownership comes a requirement for at least a basic understanding of various aspects of small business management. Examples of this are basic accounting statements such as profit and loss, balance sheet, cash flow, industrial law, human resource functions such as appointments, terminations and staff entitlements, and taxation law. Those with an understanding of basic industrial psychology and best practice in recruiting will have a considerable advantage over others in establishing and managing a team of people. The

vast majority of revenue generated by Australian optometrists comes from the sale of goods[7]. Hence optometry students should undergo education and training of retail best practice. Again, medical education can provide models for doing this in an integrated way in contrast to some of the existing standalone approaches.

Clearly, there is more to optometric practice than pure clinical work. Members of both the industry and the community have an expectation of high service levels and that practices are well equipped and have a modern "product offering." In turn, as optometry practices are expensive to equip, maintain and manage, the sustainability of a practice and the ability to service the community is inescapably bound to revenue and profitability. Graduates that possess a framework for practice management, retail and commercial awareness are more likely to create sustainable practices, with better long-term outcomes for the community.

Early Clinical Exposure Leading to Extended Clinical Placements

Early clinical exposure

One of the challenges for existing optometry curricula in Australia is provision of clinical exposure for students. Optometry students may graduate having seen up to 100 patients in total. Medical students may see this number in two weeks during residential placements. Most existing programs rely predominantly on single clinics such asuniversity staff-student clinics. While these provide convenient sources of patients, the problems with the overall approach are considerable. For instance, university clinics draw from a small and selected population and many struggle to service enough patients to give students an adequate sample. In many cases, these clinics need to offer incentives to attract more patients as, invariably, there are nearby practices offering faster service and more suitable eye wear. In those teaching clinics that offer subsidized eye wear, the patient demographic is likely to be heavily skewed toward lower socio-economic status citizens, resulting again in the distortion of student experience and perception.

A practice that is becoming increasingly common in medical education is that of short-duration placements, of as little as three hours per week, beginning in the first year of study. This can be applied to private practice optometry, with supplemental observational placements in settings such as community optometric practice, ophthalmology clinics, low vision clinics, general practice, diabetes clinics, and perhaps even manufacturing and research settings to give a broader perspective.

Furthermore, one of the contentions of this paper is that if, before commencing clinical placements, students were already masters of the mechanics of clinical practice then they would adapt more quickly. Indeed, this is supported by research on medical students who were exposed to intensive procedural skills preparation prior to clinical placements[23]. In turn, while on clinical placement the students' attention could be freed to assimilate knowledge and clinical findings, which in traditional medical programs can be problematic[24]. The aim is for graduates who can easily make the transition from students to health professionals, which is particularly relevant for those that will work in less supported environments in rural and regional Australia and other areas of need.

Medical schools that have introducedcourses in clinical skills, which are undertaken prior to seeing patients, have found measurable changes across a range of domains. These include better adaptation, comfort levels and interpersonal and communication skills[25,26], as well as improved procedural skills, educational attitudes, initiative, attendance and dependability[27]. New optometric curricula should have dedicated clinical skills subjects beginning with fundamentals such as history-taking, basic eye examination techniques with progression through to the most technically difficult tasks, and interpretation of investigations. These fundamental skills can effectively be learned using observation and participation among the students themselves, with actors or "virtual" patients[28,29].

For medical students, the advantage of early exposure has been found to be two-fold. The first is a higher degree of motivation and confidence towards practice[30] with a greater awareness of the needs of the community, the challenges facing practitioners and the strategies that they employ to address them. The second, largely intangible, benefit is that students begin their behavioral transition to practitioners and begin to identify with the profession from a very early stage because learning clinical skills in the years before seeing real patients makes basic science feel more relevant. Early exposure to primary care medicine has been found to lower attrition rates for those with a career interest in this field[31], a finding that is relevant to Australian optometry, which is at risk of undersupply[2].

Clinical placements

In order to practice safely and productively following graduation, it is important that practitioners-in-training see an adequate volume of patients, which is why essentially every medical program uses extended clinical placements. Indeed, medical students in Australia spend between two and threeyears "based" full-time in various hospitals and other clinical settings prior to graduation[32], which translates to some 1,500 hours.

Invariably, students on placement continue to receive lectures and theory-laden tutorials. However, the emphasis is on "clerking," interviewing, examining and following the progress of patients combined with bed-side tutorials and unit meeting attendance. There is a commitment to spending time on the ward or clinic during which valuable lessons are learned through the serendipity of observation and impromptu tutorials.

Due to the expansive nature of medicine, it is difficult to ensure a consistent experience for all students. All Australian medical schools aim to expose students to general medicine, general surgery, emergency medicine and general practice, as well as pediatric, obstetric and psychiatric medicine, but there is variability in the exposure to rural and indigenous health issues and specialty practice[32]. On the other hand, the relatively narrow range of optometric settings is ideal for clinical placements. Indeed, consistency of exposure during placements can, more or less, be assured. There are relatively few Australian optometrists in specialist practice where the range of conditions seen is

restricted. There are some examples in low vision, pediatrics, post-graft, rigid contact lens fitting and ophthalmic prosthetics, but these are not common.

The shortcomings of traditional clinical exposure in university staff-student clinics are set out previously. Optometry students should undertake placements that deliver on the order of 500 to 1,000 hours of practical exposure. Even allowing for long consultations and involvement in non-patient activity, students undertaking such placements will be able to interact with 1,000-3,000 patients. The opportunities for early clinical exposure and for extended placements allow the new optometry programs to build on and extend the clinical skills taught in other programs through progressive development and intensive practice and reinforcement. In addition, optometry students should use long case presentations, well-used as a clinical teaching approach across all medical disciplines, to augment the development of clinical synthesis, reasoning and communication[33].

The main challenge to this aspect of the model pertains to the identification and accreditation of practices that are willing to provide clinical placements for students, especially in Australia where almost all optometry practices are private. Receiving practices need to be equipped to accommodate students with additional consulting rooms and fit out. Students may slow down appointments, and there is no government Medicare funding for consultations performed by students.

Case-Based Learning: Facilitating Student-Centered Inquiry

Problem-based learning (PBL), pioneered in the 1960s by McMaster University in Canada, is a student-centered educational strategy[34]. It is characterized by collaborative, reflective and self-directed learning that is stimulated by open-ended and deliberately ill-defined problems (clinical cases) presented and worked on in small groups. PBL has been adopted by the majority of medical schools in Australia and is generally preferred by both students and educators to traditional teaching methods[35]. PBL has been found to deliver positive benefits for physician competency after graduation, particularly in social and cognitive domains[36].

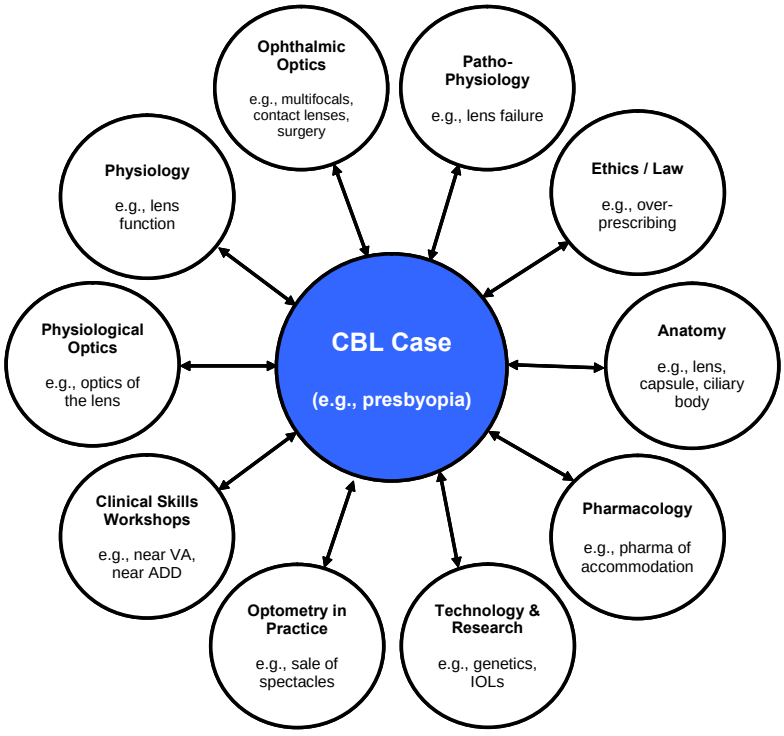
Case-based learning (CBL) is an adaptation of PBL[37] in which small groups of students solve problems creatively, with more advanced preparation than is usually found in PBL. Cases are created in such a way that, with the guidance of tutors, students uncover underlying intended learning outcomes. In practice, groups of up to 10 students attend two CBL tutorial sessions per week. One is held at the beginning of the week, and the other is held at the end. The first session introduces "the case" of a specific patient and his/her presentation. Over the course of their work, students will encounter dozens of different cases, thus enabling educators to control both the breadth and depth of conditions studied.

The task of the students, in considering the diagnosis and management of the patient in the case, is to analyze certain facts, develop hypotheses and with these identify a priority list of learning objectives. By necessity, students will encounter all relevant disciplines, including the psycho-social, legal and ethical elements of practice. CBL lends itself well to the integration of medical ethics throughout the curriculum by developing an appreciation for issues such as privacy and confidentiality, the practitioner-patient relationship, consent, negligence and potential conflicts of interest within each case.

Within a CBL session, a teacher's primary role is to facilitate discussion and debate and the prioritization of intended learning outcomes. Subsequently, students set about, over the course of a week, to meet their intended learning outcomes. This is achieved through private study and supporting sessions delivered through various media, including live and online lectures and workshops. The content of the supporting sessions is drawn from the traditional disciplines of anatomy, physiology and optics, but also includes an optometry-in-practice stream in which students are exposed to problems such as staff management, choosing the right lens for patients and over-prescribing. The second CBL session of the week is dedicated to group evaluation, integration and discussion of information, and to explaining or resolving the case[38], hence settling the intended learning outcomes.

Figure 1 illustrates a typical CBL case of presbyopia. Within the CBL sessions, students encounter the case of a patient with presbyopia as represented in

Figure 1
Case-Based Learning Prototype of Presbyopia with Contributions from Optometric Conditions



the central circle. As for a real patient, the case contains complexities within the clinical, psycho-social, ethical and commercial domains. In attempting to resolve the case, with the guidance of a tutor, students identify and record intended learning outcomes, which are subsequently achieved through a combination of private study and supporting sessions and group study. In this example, lecture topics fall within traditional optometric disciplines represented as surrounding circles.

CBL provides a learning platform for each step the students take toward becoming graduates, which can be reinforced by the supporting sessions in a so-called "hybrid" curriculum. This differs substantially from traditional curricula in which lectures represent a means of delivering self-contained units of knowledge, typically organized into disciplines. In a more traditional curriculum, optometry students may undertake studies in a discipline such as anatomy over the first two years, but not thereafter. In a CBL curriculum, specific anatomy lectures are delivered throughout the entire curriculum through vertical streaming as required to fulfill CBL learning objectives. In a CBL course, lectures build knowledge around the case, in order for students to achieve the learning objectives for the week. The obvious advantage of this structure is that information is received in the context of real clinical problems and this is how knowledge must be applied after graduation. The study of optometry is amenable, arguably moreso than medicine, to CBL because of the relatively small number of disorders and presentations. It is conceivable that a very high proportion of themes and conditions seen in practice could be covered, over three- or four-year degree programs, using CBL, with repeated coverage of the most common issues.

The key challenges for CBL are the provision of intensive faculty training and the high demand for resources for writing a large number of cases and facilitation of small group learning sessions. Furthermore, there is a need to regularly refresh cases and update intended learning outcomes, in line with changes in the competencies required for accreditation. While it is claimed that PBL is a more staff-intensive model of curriculum, the Australian medical schools that have adopted it have done so without significant increases in staffing. Rather, there has been a change of roles for staff. Indeed there is no evidence that PBL schools have substantially different student-staff ratios from those that do not use such an approach. There are additional requirements in developing the initial set of cases, which has resulted in some medical schools purchasing cases from others[39]. This is not an option for optometry schools in Australia at present and additional resources may be required in the start-up phase. At present, neither Australia nor New Zealand require optometry graduates to undertake Board examinations as the institutions themselves must be accredited. Schools that are considering the introduction of CBL would do well to recruit at least some staff with experience in PBL or CBL curricula. It is equally prudent for these schools to cross-check learning outcomes against those delivered by their existing programs to ensure no significant gaps occur.

Team-Based Learning

Team-based Learning (TBL) is a relatively new teaching technique first developed by Michaelsen[40]. It has now been applied successfully within both business and medical programs[41], where it has been demonstrated to improve learning outcomes. It comprises materials and procedures designed to develop high-performance learning teams that, in turn, dramatically improve the quality of student learning. It does this by replacing or reducing lecture time, promoting teamwork, ensuring that students are prepared and on-time to class, enhancing problem-solving skills, holding students accountable for their own learning, and creating high levels of student engagement in the classroom[42].

In TBL, learners are motivated to participate in and out of class through preparation and group discussion. As with CBL, TBL class time is shifted away from the passive reception of learning material towards the integration and application of newly learned material. Teachers retain control of content and act as both facilitators and content experts. Rather than being responsible for delivering the content, teachers guide self-managed teams through learning, and contingently teach when it is apparent that core concepts have not been grasped.

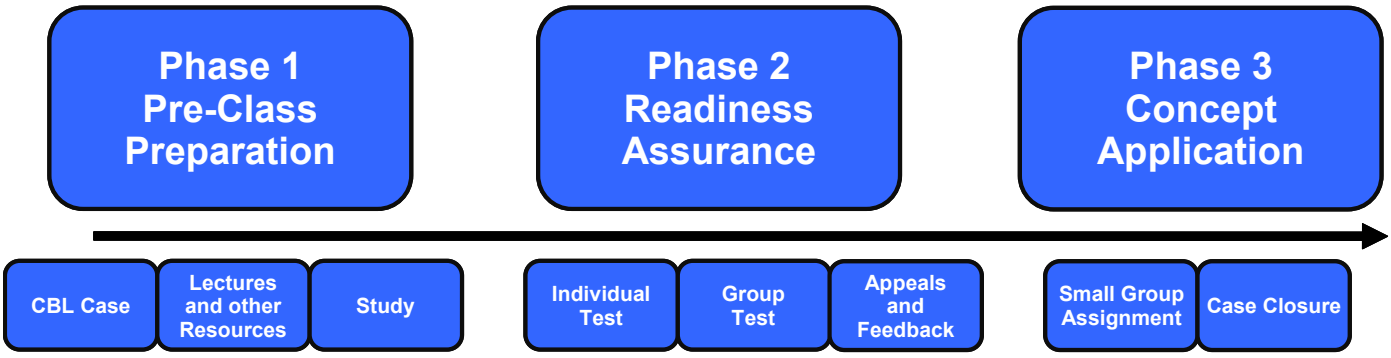
Programs that have adopted TBL report a marked increase in student attendance, student engagement and staff satisfaction[42]. It has also been found to be effective in engaging international students[40]. TBL can be applied to optometric education to effectively reduce lecture times and faculty costs while increasing student engagement. Indeed, TBL is currently being used in several U.S. optometry programs, such as the Southern College of Optometry (personal communication, J. M. Jackson, OD).

TBL consists of a three-phase sequence. In Phase 1, students are exposed to intended learning outcomes. These may, for example, be derived from a CBL case. The mastery of the intended learning outcomes comes from a variety of methods and sources, such as group and private study, traditional lectures or workshops, pre-recorded slideshows, multimedia presentations and readings.

In Phase 2, which is performed in-class, students individually complete a multiple-choice test to demonstrate their readiness to apply the material acquired in Phase 1. Individual scores are recorded but not revealed. Subsequently, teams of four to six students take the identical test together. Consensus answers are reported simultaneously, then scored and recorded immediately. Simultaneous reporting stimulates an energetic total-class discussion with groups defending their answers, thereby accelerating critical thinking and problem-solving skills. The teacher clarifies concepts and consolidates learning. This process facilitates more rapid acquisition of functioning knowledge and shared understanding of concepts and principles. It also provides time for students to access the teacher's true expertise indeclarative, procedural and functioning knowledge and assists students to learn from, and respect, their peers. Team skills such as communication, decision-making, negotiation, peer review and respect for others are inherent to TBL classes.

In Phase 3, teams collaborate in-class to solve problems that require the application of the material assessed in Phase 2. This application exercise may be scored but in many institutions this is not done

Figure 2
The Three Phases of Team-Based Learning
(adapted from Michaelsen et. al., 2004[40])



formally. The object of this phase is to extend and further consolidate prior learning. In the context of this framework, the application exercise may pertain specifically to the CBL case. TBL is illustrated in **Figure 2**.

The main challenges of delivering TBL include the need for both extensive faculty training and expert multiple-choice question writing.

Conclusion

The new optometry programs located within medical schools have provided an opportunity to adopt some of the educational reforms present in medical education. This paper describes a pedagogical and curriculum framework for optometric education in Australia derived from some of the principles of contemporary medical education. It proposes the use of backward design and outcome-based education and the incorporation of new content in interprofessional work, law and ethics, retail development, management and commercial awareness. It emphasizes the early learning of clinical skills, extended clinical placements in optometry practices and the use of case-based and team-based learning approaches. The association with medical education, which itself has undergone significant educational reform in Australia in the last two decades, is significant. It will enable optometry educators to embrace the reforms in a holistic way to provide a coherent educational program for the optometry professionals of the future. It is an important time for optometric education.

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Student and Faculty Perceptions of Factors Influencing the Clinical Learning Experience

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Abstract

Purpose: *The purpose of this study was to investigate and compare student and faculty perceptions of factors influencing the clinical learning experience. The areas investigated were: causes of stress, confidence levels and teaching interventions that contributed to the transference of knowledge from the didactic to clinical setting.*

Methods: *Students and faculty from two optometry colleges participated in the study. Focus group methodology was used and responses were analyzed to identify commonalities and trends.*

Results: *Trends related to causes of stress were: transitions, clinic scheduling, expectations, supervisor behavior, challenging patients and faculty stress. Trends related to building students' confidence were: feedback, independence and supervisor's demeanor. Teaching interventions that fostered confidence and the transference of knowledge were identified as: case discussions, seminars, skill demonstrations and questioning of students.*

Conclusion: *This study illuminated several trends that were perceived by students and faculty to impact the clinical learning environment. Student and faculty perceptions demonstrated similarities in several areas. Trends that were not identified by both groups are important to acknowledge when trying to improve the clinical environment.*

Key Words: *clinical education, stress, confidence, transference of knowledge*

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Introduction

Each year approximately 1,300 students graduate from colleges of optometry in the United States.[1] In 2000, the Association of Schools and Colleges of Optometry (ASCO) stated that the central goal of the Doctor of Optometry degree program is to prepare students to enter into the general practice of optometry and the new optometrist must possess appropriate cognitive and motor skills needed to prevent, diagnose, treat and manage clinical conditions that are within the scope of his or her professional responsibilities.[2]

Clinical optometric education is one of the primary vehicles for achieving the ASCO goals. The clinical educational environment is dedicated to promoting cognitive development, along with psychomotor, communication and related patient care skills. All clinical environments share a common challenge to provide the highest level of patient care while maintaining the highest level of education for the students. The clinical environment is composed of many factors, including physical setting, types of patients, equipment, faculty, students and support staff. Quantitative measures of factors affecting clinical learning can be complex due to the diverse influences to which students are exposed.

The student's overall learning experience is influenced by many factors. Some of these factors are concrete, such as class schedule, course load, exam schedule and pre-clinical schedules. Other factors are subjective and perceived individually by students. These factors include anxiety and stress. Anxiety and stress are common components of everyday life. Small amounts of stress have been known to be beneficial to the learning process by heightening awareness and ability to focus.[3] High levels of stress, on the other hand, can be detrimental to the student's emotional health, the learning process and patient care.[3]

A number of studies have addressed the topic of medical students' stress.[4,5] In medical education, anxiety and stress have been associated with factors such as overwhelming amounts of information presented in class, concern over grades, fear of making a mistake, lack of time for recreation and family and

financial pressures.[6] In the optometric literature, searches employing Educational Resources Information Center (ERIC), Pub Med and Visioncite using the terms "anxiety, stress, optometry students and optometric education" revealed no studies investigating stress and anxiety in optometry students.

Students' level of confidence at graduation is one outcome of their learning experience and clinical teaching. Students must pass the National Board of Examiners in Optometry exam to qualify for licensure. However, is passage of this test sufficient to foster self-confidence in students' skills in patient care? What factors influence the confidence levels of optometry students? Reports from the medical education literature suggest that there is a significant association between the number of times a task is performed and the student's self-assessed competency.[7] A search employing ERIC, Pub Med and Visioncite using the terms "confidence, optometry and graduate" revealed no research studies on this subject in the optometric literature.

For most clinical educators, teaching skills are not instinctive. Most clinical teachers are selected because of their expertise in a specific specialty and have no formal training in the educational process. Clinicians are well-prepared to care for patients but may have limited teaching skills in facilitating thought processes and guiding students to access and utilize their existing knowledge base for application in patient care. Studies in medical education show that untrained clinical teachers tend to give mini-lectures rather than conduct discussions, provide inadequate feedback to learners, and allow residents to present haphazardly or bluff their way through presentation.[7,8,9] With appropriate intervention, considerable improvement in teaching behaviors can be achieved.[10] Both seasoned and novice clinical teachers need to continuously develop and refine their teaching skills. Many clinical teachers have experienced both effective and ineffective teaching styles and are aware of the impact that poor teaching can have on a student's confidence and capabilities.

Literature from the area of medical education indicates that the quality of teaching during clinical rotations is an important determinant of medical students' learning.[11] Medical students influenced by good clinical teachers score higher on board and clerkship exams and perform better overall in clerkship experiences.[12-14]

Although some conclusions can be generalized from medical education, the educational process, along with exposure to potentially stressful situations, differs significantly in optometry compared with medicine. Medical students often encounter the risk of getting infected by patients, talking with dying or seriously ill patients or performing techniques on patients, which if done incorrectly could seriously harm the patient. The optometric profession has shown some interest in studying effective clinical teaching methodology, yet there is a paucity of research in this area.

Tolls, Carlson and Wilson, in 2003, reported on trends in optometric clinical teaching methodology and students' perception of educational effectiveness.[15] This paper found that students and faculty often have different perceptions of what is being taught in clinic.[15]

A comparison between student and faculty perceptions is important because "the difference between the world of present day students and the world that shaped the beliefs, assumptions, knowledge and skills of many of their instructors can vary."[16] Clinical education must be adaptable and respond to changes in scope of practice, standard of care, student body, faculty and healthcare policy or delivery. To meet the needs of today's and tomorrow's practitioners, optometry schools must constantly review and revise their clinical education learning experience. Information concerning how the process of clinical education works is needed to successfully respond to changing needs in clinical education and patient care.

The purpose of this study was to investigate and compare student and faculty perceptions of factors influencing the clinical learning experience. The study was limited to investigating three specific areas: causes of stress, confidence levels and teaching interventions that fostered the transference of knowledge from the didactic to clinical setting.

Methods

This study represented a collaborative effort between the New England College of Optometry (NECO) and the State University of New York, State College of Optometry (SUNY). A total of 19 graduating students from the class of 2009, nine from SUNY and 10 from NECO, participated in the study. A total of 13 faculty members, six from SUNY and seven from NECO, participated. Focus group methodology was used to gain information from both the students and faculty. Four separate focus groups (SUNY faculty, SUNY students, NECO faculty, NECO students) were held. All students were within one to two weeks of graduation. All faculty members had clinical teaching responsibilities. Direct patient care responsibilities (students having responsibility for patients from the beginning to the end of the exam) start at both institutions in the third year of education and culminate with four, full-time, three-month clinical rotations in the fourth year. Participation in the focus groups was voluntary and the participants were determined based on availability for specific dates and first responders. Both students and faculty were self-selected to participate and incentives were given to each participant.

The focus groups were facilitated by an educational psychologist, who had extensive experience in conducting focus groups. An anonymous lead question survey was used as the starting point for the discussion. Themes addressed in the survey were: stress (defined as feelings of anxiety, fearfulness, uncertainty or hopelessness), confidence levels and the clinical environment. **Table 1** depicts

Table 1
Lead Question Survey

- Identify the area(s), such as activities, behavior(s), time intervals or aspects of the clinical environment, that you feel produce the most stress while in the clinical environment.
  (Stress was defined as feelings of anxiety, fearfulness, uncertainty or hopelessness.)
- Describe a clinical incident involving a student, patient or supervisor over the last 6 months that you felt was stressful.
- What teaching behaviors contributed most/least toward increasing students' clinical confidence?
- What teaching interventions (activities, assignments) contributed most/least toward increasing students' clinical confidence?
- What teaching interventions foster the transfer of knowledge and skills from the didactic to the clinical setting?

a sampling of lead questions that were used to initiate discussion. Participating students and faculty were sent the lead question survey by e-mail to be filled out prior to the focus group, and the surveys were collected at the focus group. The purpose of the survey was only to initiate discussion. The role of the facilitator was to facilitate discussion and compile responses in a written report.

All information obtained within the focus group was anonymous and confidential. Student and faculty names were not used in any written transcripts of the dialogue.

The verbatim responses were analyzed to look for commonalities and trends. Each verbatim comment was coded to represent a theme, and the themes were compiled to represent trends.

This project was authorized by the Institutional Review Boards at both participating colleges.

Results

Verbatim responses from students and faculty were analyzed to identify themes and trends in responses. The focus group leader reported that all participants were verbal and enthusiastic about responding. A summary of identified trends is displayed in **Table 2**.

Stress

Analysis of students' comments related to causes of stress in the clinical environment yielded four main themes: supervisor behavior, transitions, clinic schedule/organization and fear of not meeting expectations/unclear expectations/unpreparedness. Analysis of faculty comments related to causes of student stress yielded five themes: transitions, clinic schedule/organization, fear of not meeting expectations/unclear expectations/unpreparedness, faculty stress and challenging patients/students' lack of experience.

Confidence

Teaching behaviors and teaching interventions (activities, assignments) were areas explored related to confidence levels. Analysis of students' comments related to teaching behaviors that contributed most toward increasing students' clinical confidence yielded three themes: feedback, independence and supervisor demeanor (respectful, friendly and enthusiastic demeanor). Factors that contributed least to confidence levels were delivery of feedback, inconsistent feedback or lack of feedback and supervisor demeanor. Supervisor demeanor characterized negative qualities such as being unreceptive, close-minded or yelling. Analysis of faculty comments related to teaching behaviors that contributed most toward increasing students' clinical confidence yielded two themes: feedback and independence. Factors that contributed least to confidence levels centered on delivery of feedback, specifically feedback delivered in a belittling or chastising manner, and lack of independence.

Table 2
Trends

Student	Faculty
Areas that contribute the most to student stress while in the clinical environment *(Stress was defined* **as** *feelings of anxiety, fearfulness, uncertainty or hopelessness)*	
• transitions • clinic schedule and organization • fear of not meeting expectations/ unpreparedness/unclear expectations • supervisor behavior	• transitions • clinic schedule and organization • fear of not meeting expectations/ unpreparedness/unclear expectations • challenging patients/students' lack of experience • faculty stress
Teaching behaviors that contributed most toward increasing students' clinical confidence	
• feedback • independence • supervisor's demeanor-respectful, friendly and enthusiastic	• feedback • independence
Teaching behaviors that contributed least toward increasing students' clinical confidence	
• inconsistent feedback/no feedback/delivery of feedback • supervisor's demeanor-unreceptive, close-minded or yelling	• delivery of feedback-belittling manner • lack of independence
Teaching interventions (activities, assignments) that contributed most toward increasing students' clinical confidence	
• case discussion • reading/writing assignments • seminars/grand rounds/presentation	• case discussion • questioning
Teaching interventions that contributed the least toward increasing students' clinical confidence	
• seminars/grand rounds/presentation • busy-work	• no trends
Teaching interventions that foster the transfer of knowledge and skills from the didactic to the clinical setting	
• case discussion with clinicality • questioning • skill demonstration/observation	• case discussion with clinicality

Analysis of students' comments related to teaching interventions that impacted confidence levels yielded three themes: case discussion, seminars/grand rounds/ presentations and reading/writing assignments. Teaching interventions that contributed least to confidence levels were centered on seminars/grand rounds/ presentations and busy-work. Analysis of faculty comments with regard to teaching interventions that positively impacted confidence levels resulted in case discussion and questioning of students as common themes. No trends were identified with regard to teaching interventions that contributed least to student confidence levels.

Teaching interventions that fostered the transfer of knowledge and skills from the didactic to clinical setting

Analysis of students' comments about teaching interventions that foster the transfer of knowledge and skills from the didactic to clinical setting yielded three main areas: case discussions with clinicality, questioning of students and observations/skill demonstrations. Analysis of faculty comments revealed that case discussion was the primary theme represented for teaching interventions that fostered transference of knowledge.

Discussion

Student and faculty comments are displayed in boxes throughout the text. Responses were modified to remove any identifying information, enhance readability and reduce repetition while maintaining the original intent.

Stress

Studies have reported that high levels of stress can hinder cognitive function and decision-making.[17] In the clinical environment, clinical decision-making is a key component to patient care and the educational process. Identification of perceived causes of stress can lead to interventions that may enhance the clinical learning experience. Congruence between students and faculty perceptions can enhance interventions, whereas lack of congruence can lead to frustration and potential conflicts.

Transition periods from one clinic to another were identified by both students and faculty as a cause of stress.

Students' Comments on . . . Transitions

- Changing clinic rotations was perceived as fairly stressful because "one needs to learn a new computer system and new policies in each clinic," "figuring out what to do takes time and effort," and "it takes three months to get comfortable in a clinic and then one has to move to another rotation."
- Moving from place to place to get settled without adequate time in between rotations was very stressful.
- Housing conditions and strange living conditions in the middle of nowhere was very stressful.

Radcliff and Lester (2003) found in medical school that transition periods were often highlighted by medical students as particularly stressful.[18] Greater guidance and support from medical school personnel at these critical transition periods were suggested to help alleviate stress. Students felt stress was related to changes in living conditions as well as the need to adjust to a new environment, and faculty did not elaborate on the specific causes of stress, but acknowledged that transitions did produce stress. Better preparation in terms of housing expectations, transportation and the characteristics of the new surroundings along with adequate time for travel may be helpful in ameliorating the stress of a new location.

Causes of transitional stress may also be related to fear of not meeting expectations/unpreparedness and unclear expectations at new sites. Both faculty and students agreed that expectations and being unprepared were causes of stress.

Faculty Comments on . . . Fear of not meeting expectations/unpreparedness/ unclear expectations

- The first day of a new quarter, a student showed up to a specialty clinic which was fully booked. The student had not reviewed any of the patient records and had not reviewed class notes.
- Lack of preparedness is stressful for students.
- A student not meeting increased responsibility is stressful for the student.
- Lack of consistency of expectations between sites/preceptors contributes to a student's stress.

Students' Comments on . . . Fear of not meeting expectations/unpreparedness/ unclear expectations

- Performing skills that were practiced in the lab only once was stressful.
- Applying the knowledge was also difficult and stressful.
- I was thrown into a clinical situation without any kind of orientation about the supervisor's expectations.
- It was difficult to meet supervisor's expectations because those far exceeded what we knew.
- We did not receive detailed description of what we needed to do, we had to figure it out, and that was stressful.
- Being placed into a clinical situation where one was unprepared and then not being provided with the appropriate level of supervision for the level of complexity of the encounter.

In the delivery of optometric education, a diversity of clinical experiences provides students with the breadth and depth of clinical knowledge needed for independent patient care. To achieve a diversity of clinical experiences, transitions to new clinical environments with exposure to different expectations, faculty and clinical scenarios are necessary.

Faculty need to be aware of their role in providing students with clear expectations for each clinical experience. This should include: organization of the clinic, rules and regulations, unique characteristics of patients, patient demographics, knowledge and skills needed to be successful, equipment and method of record keeping, etc. A comprehensive orientation to new surroundings could reduce the stress felt and enhance the clinical learning experience. If possible, a visit and observation period may also enhance the initial transition. Students need to be made aware of their role in taking responsibility in the educational process. Self-directed learning by students should encompass maintaining all clinical skills needed to be successful in a particular environment. Additionally, students should be proactive in investigating new environments.

Faculty and students agreed that clinic schedules and organization were causes for stress.

Faculty Comments on . . . Clinic schedules/organization

- Patient overload creates a lot of stress for the students.
- Overbooking; everybody is running around and the patients are upset because they have been waiting for a long time.
- There is a conflict between clinical teaching and seeing as many patients as you can.
- Inefficient and inconsistent scheduling; overbooked in the morning and slow in the afternoon can cause stress.
- An overbooked primary care with patients added on becomes stressful. It became all about "moving" the patients and not about the educational experience.

Students' Comments on . . . Clinic schedules/organization

- The clinic tends to be overbooked during the mornings and at the beginning of the week. This is stressful and frustrating.
- Students reported that when the clinics are overbooked, they are used as technicians instead of clinicians and this is stressful.
- Not enough time allotted to see patients. A second patient was waiting in the hallway and got really mad. He told me that he planned to complain to the hospital even after I apologized for the delay and explained the situation. During his eye exam, he told my preceptor that he needed to be transferred to another clinic for the next annual eye exam. That was very stressful to me.
- Patients waiting several hours to see a specialist is stressful.

Overbooking of patients is a reality that most clinics experience. Financial concerns, emergency patients and inadequate staffing are common reasons for overbooking patient appointment slots. Successful practice management policies require clinics to adhere to a sustainable and suitable productivity level. Most clinics also experience patients not showing up for appointments, yielding a consistent no-show rate. Significant clinic no-show rates are often compensated for by overbooking patient slots in order to maintain productivity levels. A balance of financial realities and educational ideals needs to be achieved.

Every effort by faculty and clinic administrators to modify the scheduling should be made. However, clinic scheduling may not be easily modified. Practice management courses may help students become more aware of the complexities of running a successful clinic. Discussions with students may help to increase awareness of the situation and lead to an open discussion of how to deal with the stresses involved in less than optimal patient scheduling. Discussions could include: how to deal with frustrated or irate patients, inadequate time to meet patients' needs, better methods of efficiency, chart review to familiarize students with incoming patients, etc.

Clinic scheduling, specifically overbooking, highlights the delicate balance that clinical faculty face in providing patient care while also educating students.

Two themes that were not expressed by both faculty and students were challenging patients/lack of experience and supervisor behavior. The faculty perceived that one cause of student stress was challenging patients/lack of experience. A student's lack of experience with a specific condition may make a routine patient encounter seem challenging. Students did not identify this area as a cause of stress. Students may not perceive this as a stressful situation because the ultimate responsibility of a patient is with the faculty member.

Faculty Comments on . . . Challenging patients/lack of experience

- It was also mentioned that students feel a lot of stress when confronted with a very difficult case described as "one that goes over their heads."
- Lack of experience demonstrated by students who do not know what to do for the patient at the beginning of their training.
- Difficult patients (such as Type A personalities) add to students' stress, especially if the patient had to wait for hours.
- Students' lack of experience is the main reason for stress.
- A student scheduled for patients needing services the student had not been trained for, e.g., contact lenses or examination of a child.

Supervisor behavior was perceived by students but not by faculty as a cause of stress. Supervisor behavior that is caustic, intimidating or contributes to student discomfort in front of patients has been documented to impact the learning environment.[19-21] The lack of agreement by faculty and students indicates a lack of recognition and acknowledgement by faculty that a particular behavior may produce stress. This may impact a faculty member's ability and opportunity to reflect and change behavior patterns. Appropriate faculty evaluations and feedback could increase awareness of problematic faculty behaviors.

Students' Comments on . . . Supervisor behavior

- Short temper from preceptors causes stress.
- Supervisor was reprimanding another student in front of me. I think it should have been done in private.
- Yelling is stressful.
- Doctors who don't respect us as students; a particular doctor judged me by appearance from the moment he met me.
- Working with a disorganized or nervous preceptor was stressful.
- The preceptor questioning the student in front of the patient.

Faculty also related that their own stress is a cause of student stress. Faculty stress may impact faculty behavior. Students may not perceive the challenges that faculty face in delivering both patient care and an educational experience.

Faculty Comments on . . . Faculty stress

- Faculty mentioned that their own stress can contribute to students' stress. The process could be stressful for faculty too. We know that it is stressful; we have a great responsibility with the public.
- One faculty member said that it is beneficial for the students to see that supervisors also experience stress. It is part of the profession. Even when in practice for many years one still feels a bit of stress when seeing patients.

Behaviors and interventions that impacted confidence and clinical learning

Delivery of feedback and encouraging independence were cited by both groups as behaviors that contributed to students' levels of clinical confidence Formative evaluation is the term given to feedback that is delivered during the learning phase of a skill.[22] This type of feedback enables students to correct weaknesses and repeat already perfected skills.[22]

Students' Comments on . . . Feedback

- By far, praise is the number-one technique for increasing a student's confidence. When being praised for a particular behavior, a student is much more likely to replicate it and do so to a greater extent and executed more gracefully.
- What helped most is simply encouragement, acknowledging what was done well and pointing out what was done wrong.
- Acknowledgment of a job well done, feedback.
- Feedback in the comments section of the electronic medical records grading system, this let us know what was being done right or wrong.
- While at the Veterans Administration Hospital Clinic, I was constantly rewarded for being inquisitive and discussing hypothetical patient scenarios. The more competent I felt, the more confident I felt, which in turn led to praise.
- Encouraging students on their strengths allows for one to build confidence.

Faculty also perceived the importance of feedback in contributing to confidence levels, but also acknowledged the difficulty in delivery of the feedback.

Faculty Comments on . . . Difficulty in delivery of feedback

- Many students have a hard time receiving constructive criticism or negative feedback.
- Students have a hard time accepting that one thing can be done in different ways. The fact that there are many ways of doing the same thing could be incredibly frustrating to students. This sometimes becomes a learning barrier because they want to know which way is right.
- Appropriate feedback and effective communication could help bridge a learning barrier.
- Many students are unable to admit that they are wrong or that they have made an error because they are afraid of failing an encounter.

Adult learning theory indicates that effective feedback needs to be given as close to the event as possible, secondary to firsthand observations, in a specific manner, and the feedback should be descriptive not judgmental.[23] Most clinical faculty are not trained in education. Therefore, the delivery of feedback may be an appropriate focus for faculty development.

Increasing responsibility for patient care with the goal of increasing student independence in patient care is recognized by both student and faculty as contributory to students' confidence levels. The amount of independence given to a student while maintaining efficient and safe patient care is partially directed by the individual faculty member's philosophy, as well as by the student's level of competence. Other factors previously mentioned, such as clinic overbooking and unprepared students, can also impact the ability to increase student responsibilities.

Clinical scenarios that use students as technical support should be avoided as this would further hinder the fostering of independence.

Students' Comments on . . . Independence

- Supervisors while on externship allowed us to see patients in a more independent manner, which helped me gain confidence in seeing patients on my own.
- Encouraging students to manage cases independently and then discuss the management with students are very helpful for increasing a student's clinical confidence.
- Giving me space to figure out a clinical problem on my own.
- Allowing students to come up with their own assessment and management plan.

Faculty Comments on . . . Independence

- Giving independence to students/interns is extremely important to promote a sense of confidence.
- One professor commented that the best supervisors are those who are close to the students and can tell what is going on and at the same time give them "rope" to act and perform.
- Giving students autonomy (mentioned twice).
- Not micromanaging.
- Giving independence to students/interns is extremely important to promote a sense of confidence.

Faculty Comments on . . . Philosophy toward independence

- Some faculty members prefer to give a lot of independence to their students in the clinic.
- A faculty member said, "If one gives the students clear expectations, it is easier then to give them more independence."
- Students have to learn that if they make a mistake, it is not the end of the world. They need to be responsible for their actions and giving them independence contributes to that.
- Other faculty members agreed that expectations have a lot to do with the success of students' clinical performance. It is important to give them high expectations, even when that means to pressure them a bit, one faculty member said. However, not everyone agreed. One faculty member answered that students "don't want to take risks. They want to feel safe in the environment."

Supervisor demeanor was identified by students as a theme in contributing to student confidence. Students felt that faculty behavior that was warm, insightful, enthusiastic and respectful contributed to a sense of confidence. This is consistent with faculty behaviors that are identified in the literature as constituting "good teaching."[19, 24, 25]

Personal attributes of faculty and behaviors were not perceived by the faculty as to contribute to confidence levels. This dichotomy could hamper faculty attempts to ameliorate nonproductive behavior.

Case discussions, seminars/grand rounds/presentation and reading/writing assignments were perceived by students as contributing to increasing confidence levels. Seminars/grand rounds/presentation are in reference to presentations made by faculty or residents on specific topics. These activities represent a wide range of teaching interventions, which may reflect a wide range of learning styles within the students. Faculty agreed that case discussion contributed toward increasing confidence levels but also added questioning of students as an additional area. Seminars/grand rounds/presentations were also perceived by students as interventions that were considered least influential to confidence levels. Students commented that the seminar/grand rounds/presentations that were not helpful lacked clinical relevance, represented theoretical cases or lacked relevant educational information. This indicates that the quality and relevance of the activity may be more important than the type of activity.

Students' Comments on . . . Seminars/grand rounds/ presentations

- Seminars/grand rounds on pertinent topics such as headaches, dry eye, pinhole testing, etc., were useful as review tools and learning aids before starting clinic each day.
- In one clinical system the residents/doctors give presentations and it probably was the worst grand rounds I have had to go to. The topics were not interesting or clinically relevant.

Students also perceived "busy-work" as not contributing to confidence levels. Busy-work activities ranged from educational activities viewed as nonproductive to noneducational activities such as calling patients or ordering cabinets. Calling patients or ordering supplies, equipment, cabinets, etc., although a necessary component of practice management, should be evaluated for worth and value to the student as a developing clinician.

Students' Comments on . . . "Busy-work"

- Calling patients, busy-work, ordering a cabinet does not help with confidence.
- There needs to be value within the assigned readings/assignments as busy-work does not contribute to building the student clinician and is a waste of time.
- Calling patient for specialists.

The didactic environment prepares students with a knowledge base and foundation to be utilized in the care of patients. Information acquired in the didactic environment needs to be organized and accessed by the student when in the clinical environment. Therefore, a "cognitive bridge" must be developed by the students to transfer the information.[26] Case discussion with clinicality was perceived by both students and faculty as an intervention that fosters the transfer of knowledge. Case discussion provides a context for learning and transferring knowledge. An appropriate contextual environment enhances the learning experience.[27] Case discussion provides an opportunity for the student to practice clinical decision-making, reflect on past clinical experiences, integrate knowledge and be exposed to the faculty's thought process. Incorporating case discussions and clinical scenarios into the didactic curriculum should be considered as a means of enhancing learning.

Limitations and Strength of the Study

Limitations of this study included lack of levels of quantification of responses and self-selection of participants. Levels of stress can be put on a spectrum with small amounts enhancing the learning environment and larger amounts hindering the environment. The level of stress was not quantified in this study. Although a description of stress was used as a guide during the discussion and the implication was of a nonproductive level of stress, each student's interpretation of stress was subjective. Additionally, specific diagnoses of anxiety, depression or other psychiatric disorders were not solicited from the focus group participants. Participation in the study was voluntary. Therefore, both faculty and students were self-selected and this may have led to responder bias. The small number of participants in the study is also a limitation.

A strength of the study was the collaborative effort between the two colleges of optometry. NECO is an independent, private institution with a student body of approximately 450 students. The college draws from more than 30 states and Canada. SUNY is a state-supported college with a student body of approximately 290 students. SUNY draws from more than 15 states and Canada with half of the student body coming from one state.[1] The dual institutions may yield results that are more generalizable than if the study occurred within a single institution. However, while there seemed to be general agreement between the colleges, the small number of participants in the focus groups made any systematic comparison difficult.

Conclusion

Maximizing the clinical learning experience should be a goal of all optometric educational institutions. This study illuminated several trends perceived by students and faculty to impact the clinical learning experience. Student and faculty perceptions demonstrated similarities in several areas. Trends that were not identified by both groups are important to acknowledge when trying to improve the clinical teaching environment. Faculty development programs should support faculty in areas such as the delivery of feedback and the challenge of balancing patient care and education because these areas were identified by both students and faculty in relationship to increasing student confidence.

This study provides preliminary infor-

mation about causes of stress, factors contributing to confidence levels and interventions contributing to the transfer of knowledge. However, many research questions and much information still needs to be explored. How much stress do students experience? What percentage of optometry students experience detrimental stress? How confident are students at assuming full responsibility for patient care without the benefit of a clinical instructor with whom to confer? How confident are optometry students in their ability to provide patient care at the time of graduation? Does student stress and confidence influence student career decisions, such as those involving residency and mode of practice? Are students able to identify strengths and weaknesses in their clinical skills? Qualitative studies should be pursued to gain more information about the clinical learning environment. Educational research with the goal of continuous growth and development will help to make the most of the clinical learning environment.

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Contact Lens-Related Corneal Ulcer: A Teaching Case Report

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Abstract

Corneal ulcer, or ulcerative keratitis, is essentially an open wound to the eye. It is characterized by disruption of the corneal epithelium and stroma and can be either inflammatory or infectious. This teaching case report reviews the diagnosis and management of a specific contact lens-related corneal ulcer case and includes a discussion of the differential diagnosis, risk factors, and pharmacological treatments for corneal ulcers. This topic is important because of the potentially severe ocular complications that can arise from overwear of contact lenses.

Key Words: *corneal ulcer, infectious keratitis, ulcerative keratitis, contact lens, fluoroquinolone*

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Background

Corneal ulcer, also known as ulcerative keratitis and infectious keratitis, is most often associated with contact lens use or misuse. The following case report involves a 30-year-old African-American female who developed a corneal ulcer after falling asleep in her contact lenses. It discusses the differential diagnosis, risk factors and pharmacological treatments for corneal ulcers as well as the educational component necessary to transfer the information from a didactic to a clinical setting. The case is appropriate as a teaching guide for second- third- and fourth-year students. While second-year students may benefit from a review of ocular anatomy and pharmacology, third- and fourth-year students can learn the sequence of care for a contact lens-related corneal ulcer ranging from initial diagnosis to treatment and proper patient education for the prevention of future episodes. This topic is important to teach because of the potentially sight-threatening consequences of corneal ulcers.

Student Discussion Guide

Case description

Patient GG, a 30-year-old African-American female was referred from the urgent care clinic at a neighborhood community health center on Jan. 28, 2006 for pain in her right eye (OD). She reported falling asleep in her contact lenses (CLs) two nights prior to the visit and waking the next morning with no ocular problems. She continued to wear her CLs until she removed them at noon, when the eye started to bother her. She noted burning, redness, tearing and sensitivity to light OD and stated that it "feels as if there is something in it." She had not used any eye drops and reported no discharge from her eyes. She denied any recent trauma or surgery to her eye, and confirmed she had not traveled recently to a warm and moist environment. She had not been swimming in her CLs or using tap water to clean them.

The patient was on her last pair of CLs and did not know the brand of CLs or solution used. Since she had not saved any of the blister packs, she was not able to bring them to the next visit. She did

not recall the name or location of her last eye doctor or the date of her last visit. She typically wore her CLs for 10 hours a day and replaced them every two months. This was the second incidence of falling asleep in her CLs.

The patient's medical history was positive for asthma, depression, eczema, and chronic allergic rhinitis. She was taking indomethacin, hydrocortisone cream, albuterol and hydroxyzine hydrochloride tablets. She was a nonsmoker and denied any allergies to medications. She reported no history of ocular disease, eye surgery, diabetes or collagen vascular disease. Entering distance visual acuity with her spectacle lenses was 20/25 OD and 20/20 OS. She reported the OD was blurrier than usual. The pupils were equally round and reactive to light with negative afferent pupillary defect noted OU. Anterior segment evaluation by slit lamp examination revealed clear lashes OU, meibomian gland stasis OU, grade 1 conjunctival hyperemia OD and clear conjunctiva OS. An approximately 0.5-mm, round, deep, well-demarcated white epithelial defect with stromal excavation slightly inferior nasal to the visual axis was seen OD. (A depiction of this defect is seen in **Figure 1**. It is not the actual photo of this patient.)

Use of a 0.6-mg fluorescein sodium strip OD/OS highlighted the area of the defect OD. There was also grade 2 corneal edema affecting the epithelial layer that was slightly larger than 0.5 mm OD but no hypopyon OD/OS. The anterior chamber revealed grade 2 cells and flare OD but was clear OS. The iris, angle (on Von Herrick estimation) and lens were normal OU. One drop of fluorescein sodium/benoxinate ophthalmic solution (Fluress) was instilled OD/OS, and intraocular pressures measured at 10:10 a.m. by Goldmann applanation tonometry were 13 mmHg OD and 13 mmHg OS. The tentative diagnosis at this time was corneal ulcer OD. Data from the examination on Jan. 28, 2006 are listed in **Table 1.**

Follow-up #1: Jan. 31, 2006

The patient missed her 24-hour follow-up appointment but returned on Jan. 31, 2006, three days after her initial visit. She reported a 50% improvement in redness, pain and irritation OD. As prescribed at the initial visit, she had

Figure 1
Example of a corneal ulcer (reprinted with permission from Dr. Joseph Sowka).

Table 1
Initial Presentation: Jan. 28, 2006

	OD	OS
Distance VA with glasses	20/25	20/20
Pupils	Pupils equal, round and reactive to light (PERRL) Negative afferent pupillary defect (APD)	PERRL Negative APD
Significant anterior segment findings	Grade 1 conjunctival hyperemia Round, deep, well-demarcated white epithelial defect with stromal excavation ~ 0.5 mm in size slightly inferior nasal to visual axis Grade 2 corneal edema No hypopyon	Clear
Fluorescein staining	Positive staining depicted an excavated corneal defect	Clear
Anterior chamber	Grade 2 cells and flare	Clear
Intraocular pressures (GAT) @ 10:10 a.m.	13 mmHg	13 mmHg

been using moxifloxacin (Vigamox) five times per day OD and cyclopentolate (Cyclogyl) bid OD. She had also been using over-the-counter Walgreen's artificial tears three times per day, which had been recommended by the store pharmacist. The patient reported no changes to vision or health since the last eye exam.

Distance visual acuity with spectacle correction was 20/30+2 OD and 20/20 OS. Pupils were equally round and reactive to light with negative afferent pupil defect noted OU. Anterior segment evaluation with slit lamp revealed clear lashes OU, mild meibomian gland stasis in the lids OU, grade 1+ hyperemia in the inferior conjunctiva OD and no hyperemia OS. A corneal scar, approximately 0.5 mm, was present slightly inferior nasal to the visual axis OD. A 0.6-mg fluorescein sodium ophthalmic strip was instilled OD/OS, which revealed inferior punctate epithelial erosion (PEE) OU and no staining in the area of the ulcer OD. All other structures, including the iris, angle and lens were unchanged from the previous visit. The secondary anterior chamber reaction had resolved. One drop of fluorescein sodium/benoxinateophthalmic solution was instilled OD/OS and revealed intraocular pressures of 12 mmHg OD and 12 mmHg OS at 9:30 a.m. by Goldmann applanation tonometry. Data from this examination is shown in **Table 2**.

Table 2
Follow-Up #1: Jan. 31, 2006

	OD	OS
Distance VA with glasses	20/30+2	20/20
Pupils	Pupils equal, round and reactive to light (PERRL) Negative afferent pupillary defect (APD)	PERRL Negative APD
Significant anterior segment findings	Grade 1+conjunctival hyperemia Corneal scar ~0.5 mm slightly inferior nasal to visual axis	Clear
Fluorescein staining	Inferior punctate epithelial erosion (PEE) No staining in area of ulcer	Inferior punctate epithelial erosion (PEE)
Anterior chamber	Clear	Clear
Intraocular pressures (GAT) @ 9:30 a.m.	12 mmHg	12 mmHg

Table 3
Follow-Up #2: Feb. 3, 2006

	OD	OS
Distance VA with glasses	20/25+1	20/20
Pupils	Pupils equal, round and reactive to light (PERRL) Negative afferent pupillary defect (APD)	PERRL Negative APD
Significant anterior segment findings	Corneal scar ~ 0.5 mm in size inferior nasal to visual axis	Clear
Fluorescein staining	Clear	Clear
Anterior chamber	Clear	Clear
Intraocular pressures (GAT) @ 1:20 p.m.	10 mmHg	10 mmHg

The assessment was that the patient had a resolving corneal ulcer OD with resultant stromal scar and resolved secondary uveitis OD. The patient was instructed to continue moxifloxacin fives times per day OD and to discontinue the cyclopentolateas her pain had subsided. The patient was also instructed to discontinue the Walgreen's artificial tears and to start using preservative-free artificial tears (TheraTears) tidOU to treat the superficial punctate keratitis. She was to return in three days for follow-up or sooner with worsening symptoms or pain.

Follow-up #2: Feb. 3, 2006

The patient returned three days later on Feb. 3, 2006. She reported improved vision with no pain, redness, tearing or discharge OD. The patient was still using moxifloxacin five times per day, last dosed a half hour prior to the visit. She was also using preservative-free artificial tears as instructed tid OU. She reported no changes to vision or health since the last eye exam.

Distance visual acuity with spectacle correction was 20/25+1 OD and 20/20 OS. Pupils were equally round and reactive to light with negative afferent pupillary defect noted OU. Anterior segment evaluation by slit lamp revealed clear lashes OU, meibomian gland stasis OU, and clear conjunctiva OU. A corneal scar approximately 0.5 mm in size was seen inferior nasal to the visual axis OD. One 0.6-mg fluorescein sodium ophthalmic strip was instilled OD/OS and revealed mild inferior PEE OU and instantaneous tear break-up time (TBUT) OD/OS. All other structures including iris, angle, anterior chamber and lens remained unchanged OU. One drop of fluorescein sodium/benoxinate ophthalmic solution was instilled OD/OS and revealed intraocular pressures of 10 mmHg OD and 10 mmHg OS at 1:20 p.m. by Goldmann applanation tonometry. Lensometry indicated a prescription of -5.25 sphere OD and -5.00 sphere OS. Data from this examination are shown in **Table 3**.

The diagnosis was stromal scar resulting from corneal ulcer due to CL overwear OD and meibomian gland stasis with secondary dry eye OU. The patient was instructed to discontinue moxifloxacin and to continue the preservative-free artificial tears tid OU. She was advised on warm compresses bid and lid scrubs bid OU for the meibomian gland stasis. The patient was asked to return in two weeks for a comprehensive eye exam and CL fitting. She was instructed to discontinue CLs until her next visit. She was educated on the risks of extended wear and the need for proper lens care. She was to return to the clinic sooner than two weeks if any of the symptoms of pain, redness or decreased vision resurfaced. Unfortunately the patient did not return.

Learning objectives

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

1. Describe the corneal ocular anatomy and metabolism in relationship to microbial infection and its consequences.
2. Describe the etiology and differential diagnosis of a corneal ulcer.
3. Describe the evidence needed to diagnose an infectious corneal ulcer.
4. Identify the risk factors associated with a corneal ulcer.
5. Identify treatment options, including standard of care, implications of the management plan and evidence-based medicine.
6. Determine appropriate contact lens fitting options after corneal ulcer resolution.
7. Differentiate between inflammatory and infectious corneal ulcers.

Key concepts

1. The pathophysiology of a corneal ulcer, including bacteria invasion of cells and tissue response.
2. The body's natural immunological response to bacterial invasion.
3. The role of medication in enhancing the body's response to an invading organism.
4. The role of CL wear in influencing corneal metabolism and increasing susceptibility.

Discussion topics

1. Ocular anatomy of the cornea
   a. layers of the cornea
   b. blood supply to the cornea
   c. metabolic activity of the cornea
   d. scarring in the cornea
2. Etiology and differential diagnosis of corneal ulcers
   a. differentiating between bacterial, fungal, acanthamoebic and herpes types
   b. how bacteria invade tissue
   c. signs and symptoms
3. Evidence needed to diagnose
   a. history of CL wear
   b. physical exam and signs of corneal ulcer
   c. staining pattern of corneal ulcers
   d. culture use, e.g., when to culture and what to do when not equipped to culture
   e. inflammation vs. infection
4. Risk factors for corneal ulcer
   a. decreased oxygen related to CLs, DK, materials, oxygen exchange of CLs vs. oxygen demand of cornea
   b. care of CLs and case disposal, including improper disinfection with water
   c. role of dry eye, blepharitis, being immunocompromised, etc., in increasing risk of corneal ulcer
   d. role of environmental and other factors, such as age, gender and tobacco use, in increasing risk of corneal ulcer
   e. soft CLs vs. gas permeable CLs
5. Treatment options
   a. pharmacological treatment, including off-label use, mode of action of drug, use of steroids, dosage and standard of care, differences between the fluoroquinolones
   b. patient education
   c. complications and implications
6. Contact lens use after corneal ulcer resolution
   a. when to restart CLs, when to refit CLs
   b. patient education
   c. gas permeable CLs vs. soft CLs

Educational Guidelines

Literature review

Corneal ulcers, although debilitating and potentially sight-threatening, are quite a rare disease entity. The incidence of ulcerative keratitis caused by contact lenses is believed to be approximately 71,000 cases per year, with an average of 1.7 ulcerations annually per practitioner[1]. A corneal ulcer is caused by a break in the corneal epithelium and/or stroma and can lead to the entrance of a micro-organism through the break[2]. Although more common unilaterally, it can present bilaterally and can vary in size and severity[1]. Patient demographics include younger patients and those living in developed nations, both who are more likely to wear contact lenses[3]. Corneal ulcers are more common among males due to their greater likelihood of sustaining ocular trauma[6,9]. The etiology can be bacterial, fungal, parasitic or viral and will determine the course of treatment. Other less common risk factors for corneal ulcers include trauma, dry eye, exposure keratopathy and lid abnormalities[4]. With delays in treatment, or when left untreated, corneal ulcers, especially those centered along the visual axis, can be quite serious and sight-threatening[5].

A major risk factor for developing a corneal ulcer is overnight use of soft contact lenses, and the risk increases with each consecutive night of continuous wear[6,7]. The closed-eye environment causes metabolic stress on the cornea by trapping bacteria from tear stasisand allowing pathogenic bacteria to invade the vulnerable and compromised cornea[8]. It appears that lens to cornea interactions during lid closure contribute more to corneal hypoxia than the actual characteristics of a contact lens such as oxygen permeability[6,9]. Thus, new contact lens materials such as silicone hydrogel (which have higher DK) have been developed in recent years to increase oxygen permeability and reduce corneal hypoxia that contributes to corneal ulcer formation[9,12].

In addition to overnight contact lens wear, other risk factors for corneal ul-

cers include poor lens hygiene, use of homemade saline solutions, reuse of contact lens solutions, the use of tap water without proper drying, poor case hygiene such as not replacing cases regularly and delayed lens replacement[11,15,16]. In addition, environmental factors, such as climate and temperature, affect the risk for corneal ulcers. For example, the higher incidence of Gram-positive organisms in temperate zones[13] and higher incidence of CL wearers in developed nations have likely resulted in a greater number of microbial keratitis cases here[2]. A study has indicated a 30% increase in microbial keratitis in developed countries[2].

In addition to risk factors, it is important to understand the relationship between corneal anatomy and ulcers. The cornea is a multi-layered epithelial sheet broken down into five distinct layers: epithelium, Bowman's layer, stroma, Descemet's membrane and endothelium[17]. Of these, the stroma, which makes up 90% of the cornea, is the largest. The cornea has an arsenal of defenses, including the antimicrobial properties of the tear film and the physical tight cellular junctions of the corneal epithelium. In order for microbial keratitis to occur, an organism must penetrate through the stromal layer[11]. Scarring can ensue when the defect affects the stromal layer or beyond. A corneal ulcer can vary in size, depth and severity. It is best viewed with different illuminations on the slit lamp. Initially, a wide diffuse illumination is used to locate and obtain a gross view of the lesion. A parallelopiped illumination allows for a more three-dimensional view of the lesion, and an optic section can be used to assess the depth of the lesion. Sodium fluorescein dye is used to highlight the area of epithelial defect. Positive fluorescein staining often contours to the shape of the lesion.

A corneal culture is indicated in certain scenarios. A culture is warranted when the corneal ulcer is large (>2 mm), greater than one-third the thickness of the cornea, centered along the visual axis, occurs in "at risk" populations (i.e., elderly, immunocompromised or monocular patients), or does not respond to antibacterial treatment[7]. Corneal scrapings and cultures are needed in many cases to determine the causative organism. Cultures should also be taken of the patient's contact lenses and solutions[1,15]. A study found that 67% of negative corneal scraping cases showed a positive contact lenses culture[1].

Although new multi-purpose solutions and no-rub formulations have been developed in recent years to improve patient compliance, they have not been as effective against certain microbes such as *Acanthamoeba* and *Fusarium*. The outbreak of *Fusarium* keratitis in the United States between June 2005 and July 2006 resulted in 164 confirmed cases and was linked to the use of MoistureLoc multi-purpose solution[13,16]. Studies have also found that most CL-related corneal ulcers are bacterial in origin (60%) followed by fungal (38%) and *Acanthamoeba* keratitis (2%)[5]. The overwhelming majority have found *Pseudomonas aeruginosa* to be the main causative bacterial organism[1,17,18,19]. *Pseudomonas* thrives because it survives the moist environment of contact lenses storage cases and solutions and can quickly cause destruction of the cornea[1]. Other less common bacterial isolates include *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Serratia marcescens* and *Moraxella* species[20].

The differential diagnosis of ulcerative keratitis includes: contact lens associated red eye (CLARE), infiltrative keratitis, corneal ulcer, contact lens peripheral ulcer (CLPU) and microbial keratitis.

- CLARE is an acute unilateral inflammatory sterile keratitis associated with colonization of Gram-negative bacteria on contact lenses (usually *Pseudomonas*). The typical patient wears extended-wear hydrogel lenses and awakens with ocular pain, tearing, variable decreased vision and photophobia. There are mid-peripheral corneal infiltrates in severe cases. Cases are usually resolved by discontinuing CL wear[11,15]. Hence, sterile keratitis is more benign and is not usually associated with vision loss.The incidence of sterile keratitis linked to contact lens wear is in the range of 1% to 7% of soft lens wearers annually[6].
- Infiltrative keratitis is a cellular response in which corneal infiltrates or multiple discrete aggregates of gray or white inflammatory cells invade the cornea. They usually occur near the limbus but can present anywhere. They are commonly associated with contact lens overwear and usually present later in the day. Management is best achieved by discontinuing CL wear[15].
- Corneal ulcer is an umbrella term for an inflammatory or infectious event that is characterized by redness, pain and sometimes decreased vision. Examples of corneal ulcers include inflammatory CLPU or infectious microbial, fungal or *Acanthamoeba* keratitis. In infectious corneal ulcers, both Gram-positive and Gram-negative bacteria can colonize the corneal surface. Symptoms can vary from mild to severe. Treatment is best with a broad-spectrum antibiotic[7].
    - o CLPU is a unilateral inflammatory event usually associated with extended-wear silicone hydrogel lenses. It is characterized by a small, sterile whitish gray ulcer typically located at the corneal-limbal border. It is usually caused by colonization of the contact lens surface by pathogenic Gram-positive bacteria, usually *Staph aureus* or *Staph epidermidis*. It is usually limited to the epithelium and not associated with much anterior chamber reaction or significant pain. Symptoms may range from mild to moderate. Discontinuing CL wear usually helps to resolve the condition[11,15]. It can also be treated with topical antibiotics or steroids[6].
    - o Microbial keratitis is a serious infection of the cornea characterized by excavation of the corneal epithelium, Bowman's layer and stroma with infiltration and necrosis of tissue[15]. It can cause vision loss with a risk of 0.3 to 3.6 per 10,000[8]. The incidence ranges from 1.8 to 2.44 per 10,000 CL wearers per year[13]. The risk is higher with soft contact lenses compared to rigid gas permeable lenses (2/3 compared to 1/3)[13]. Approximately 10% of infec-

tions result in the loss of two or more lines of visual acuity[14]. Symptoms are typically severe and the condition can become sight-threatening. It is most often associated with *Pseudomonas spp*, a Gram-negative bacteria. Treatment is best with a broad-spectrum antibiotic, such as a fourth-generation fluoroquinolone[15].

Treatment for corneal ulcers includes removing the offending agent, which in many cases means discontinuing CL wear. Cool compresses may be applied for symptom relief. Patients should be counseled to not touch or rub their eyes and to engage in proper visual hygiene, including frequent hand-washing. They may take over-the-counter medications such as acetaminophen or ibuprofen for pain[14].The most effective treatment is an ophthalmic eye drop. In the past, aminoglycosides such as gentamicin and tobramycin were readily used[14]. Although they demonstrated good Gram-negative bacterial coverage, they also revealed significant hypersensitivity in documented cases[14]. Today, fluoroquinolones (second-, third- and fourth-generation) are more popular. A dilation drop such as cyclopentolate may be administered to relieve pain or inflammation[14]. The use of steroids in bacterial keratitis is controversial[18]. While some advocate topical steroids to reduce tissue damage and scarring, others fear that steroids will reduce the cornea's immune response and prolong infection[21]. A study found that steroid treatment delayed corneal re-epithelialization but did not cause a significant difference in visual acuity or scar size[20]. In worst-case scenarios, a surgical corneal transplant may be indicated if the ulcer perforates the cornea[19].

The second-generation fluoroquinolones, ciprofloxacin 0.3% (Ciloxan) and ofloxacin 0.3% (Ocuflox), were introduced in the 1990s and are FDA-approved for the treatment of bacterial conjunctivitis and keratitis[22]. Although these broad-spectrum antibiotics target both Gram-positive and Gram-negative organisms, their effectiveness has been steadily decreasing due to bacterial resistance[22]. Ciprofloxacin has demonstrated the greatest effectiveness against Gram-negative bacteria such as *Pseudomonas aeruginosa* and multi-drug resistant Gram-negative organisms[14]. The third-generation fluoroquinolone levofloxacin 0.5% (Quixin) was introduced in 2000 and is more water-soluable than ofloxacin at a neutral pH, meaning it demonstrates higher ocular concentrations and thus greater clinical efficacy. Levofloxacin also has increased activity against *Streptococci* compared to second-generation fluoroquinolones. A newer formulation of levofloxacin with ahigher 1.5% concentration (Iquix) has also been approved by the FDA[24]. Although the minimum inhibitory concentration (MIC) for both concentrations of levofloxacin is the same, the increased concentration of levofloxacin 1.5% improves its ability to penetrate ocular tissue[22]. The MIC is the lowest concentration of an antimicrobial that will inhibit the growth of a micro-organism after overnight incubation. Two newer fluoroquinolones, introduced in 2003, moxifloxacin 0.5% (Vigamox) and gatifloxacin 0.3% (Zymar) are statistically more potent than Quixin against Gram-positive organisms and similar in potency in most cases of Gram-negative bacteria.A study found that moxifloxacin had significantly lower median MICs for nearly all types of Gram-positive isolates than gatifloxacin[24]. However, moxifloxacinand gatifloxacin demonstrated equal susceptibility to Gram-negative isolates[22]. Although moxifloxacin and gatifloxacin are not FDA-approved for the treatment of bacterial corneal ulcers, they are typically used as "standard of care" treatment[23]. A major difference between these fluoroquinolones is that the second- and third-generation fluoroquinolones act on a single DNA-replicating enzyme while the fourth-generation fluoroquinolones target two DNA-replicating enzymes, thus lowering the likelihood of bacterial resistance[24].

There are numerous reasons moxifloxacin seems to be more effective and was chosen for treatment (in this case) over gatifloxacin and the second-generation fluoroquinolones. Studies show that moxifloxacin penetrates the cornea and aqueous humor significantly better than gatifloxacin[6]. Likewise, moxifloxacin was found to have 10 times the MIC for an organism, while gatifloxacin did not[25]. This means that moxifloxacin is more bactericidal and can penetrate into the aqueous humor with four times daily dosing[25]. Moxifloxacin is also 8-16 times more potent against Gram-positive organisms than previous-generation fluoroquinolones[26]. Moxifloxacin has been found to be resistant against methicillin-resistant *Staph aureus* (MRSA). Moxifloxacin has broad-spectrum coverage and excellent activity against Gram-negative organisms, such as *Pseudomonas aeruginosa*. Although ciprofloxacin has historically been the fluoroquinolone of choice for the treatment of *Pseudomonas*, it does not penetrate the cornea as well as moxifloxacin[26]. Moxifloxacin differs from gatifloxacinin that it is a biphasic molecule, meaning it is soluble in both lipid and aqueous solutions[26]. This allows it to achieve very high concentrations in the eye. Lastly, moxifloxacin has less corneal and conjunctival toxicity than the other fluoroquinolones, including gatifloxacin and Quixin[22].

Since this patient was treated, a new fluoroquinolone, besifloxacin 0.6% ophthalmic suspension (Besivance), has become available. It is a fourth-generation fluoroquinolone that was approved by the FDA in 2009 for the treatment of bacterial conjunctivitis[27]. It is the first fluoroquinolone developed specifically for ophthalmic use. In other words it has no systemic counterpart[28]. With no systemic use, studies have shown that besifloxacin is less likely to develop bacterial resistance than other fluoroquinolones[29]. Because this drug is still relatively new, more studies need to be conducted to determine drug resistance and efficacy.

Discussion

Gathering information

In the case presented, the young woman reported generic symptoms of eye pain and redness in one eye. The astute clinician should ask probing questions about the circumstances surrounding the symptoms as well as CL use and recent ocular trauma. If CL wear is established, specific questions regarding the history of CL wear should be addressed.The clinician should inquire about the type of CLs worn as well as the type of CL solution used as these factors can contribute to the type of

infection presented. In this case unfortunately, the patient did not know the type of CLs worn or the CL solution used. Although this information can be useful, clinical decision-making often requires the clinician to make reasonable judgments based on the information available.

Confirmation of diagnosis

The diagnosis at first visit was corneal ulcer with secondary uveitis from CL overwear OD. This was determined mainly from the patient's report of sudden onset redness and pain after falling asleep in her CLs along with the presence and location of a paracentral circumscribed corneal infiltrate with stromal excavation producing positive staining. Other differentials were considered and ruled out. For instance, herpes simplex was ruled out because fluorescein staining did not show a typical dendritic pattern. Fungal keratitis was ruled out because the patient denied any recent ocular trauma and the lesion did not present a feathery border. *Acanthamoeba* keratitis was ruled-out because the patient did not swim in her CLs and did not recently travel to a warm and moist environment. The process of clinical decision-making involves justification of diagnosis as well as ruling out other potential diagnoses.

Management

Treatment with antibiotics should be aggressive and immediate in most cases to eradicate the potential microbe. The patient was advised to return in 24 hours but because the clinic was not open on the weekend, she returned the following Monday[30]. The patient was advised to go to the emergency room if symptoms worsened over the weekend. A culture was not taken in this case because the corneal ulcer was small, not on the visual axis and responded to treatment. Although obtaining a corneal scraping is recommended before prescribing antibiotics, standard of care as stated in American Optometric Association guidelines does not require obtaining a corneal culture[30].

Patient education

The patient was counseled to throw away her current CLs and to stay out of them until the condition resolved. Close follow-up care is crucial to prevent rapid visual deterioration from any potential microbe or organism. At the first visit, a prescription was given for moxifloxacin 0.5% ophthalmic solution to be used every 30 minutes OD that day and then every hour OD for the next two days. Cyclopentolate 1% bid OD was also prescribed to temper the anterior chamber reaction, to prevent a posterior synechiae, and to reduce eye pain. Moxifloxacin was chosen over the second-generation fluoroquinolones because of its greater spectrum of coverage, lower antibacterial resistance and ease of dosage. It was chosen over gatifloxacin because of its longer half-life (and thus less-frequent dosing schedule) and greater penetration into the cornea[24]. Also, it has a lower incidence of toxicity and is preservative-free[31]. Besifloxacin may be a good choice due to its lower dosing schedule.

Follow-up

The patient was instructed to go to the emergency room with any increased pain or decrease in vision over the weekend. An appointment was scheduled for the following Monday because the clinic was not open on the weekend. The patient was warned about the potential for a slight vision reduction after resolution of the ulcer. Her primary care physician was notified of the findings.

Resolution of ulcer

CL wear can resume only after the corneal ulcer has healed. It is important to choose CLs with high oxygen permeability (DK), such as silicone hydrogel lenses. Many variables, such as oxygen content and replacement schedule, must be considered when selecting new CLs. Acuvue Oasys, PureVision, or Ciba Night & Day would be suitable options for refitting because they are all silicone hydrogel lenses that allow for greater oxygen permeability and all are approved for overnight wear[6,11]. Although sleeping in contact lenses is still not recommended despite labeling for overnight wear, patient noncompliance is common. Therefore, it is advantageous to fit more highly oxygen permeable CLs. In this case, Acuvue Oasys was the desired lens because it is not only made of silicone hydrogel but also has a two-week replacement schedule (as opposed to the monthly replacement schedule for the other two silicone hydrogels). A suitable alternative, if the patient is willing to try a different modality, is a daily disposable CL. One example is 1-Day Acuvue TruEye, the first daily disposable silicone hydrogel lens, which debuted in June 2010 in the United States. Frequent replacement of CLs helps to prevent long-term buildup of proteins and deposits on the lens surface. Therefore, it is important to educate patients on the replacement schedule for their CLs. In addition to selecting the most suitable CLs, it is important to educate patients on proper hygiene, including lens cleaning and care regimens and frequent case replacement. Patients must be counseled extensively to not overwear CLs and to not sleep in them. Rigid gas permeable CLs are another alternative to soft contact lenses but they are often less desirable for patients who are already accustomed to the comfort of a soft CL. Rigid lenses also allow favorable oxygen permeability to the cornea.

As illustrated by this case, corneal ulcer therapy involves not only removal of the offending agent but also use of topical agents including antibiotics, a culture when warranted, a change in CL materials and fit, and modification of CL maintenance and care.

Conclusion

This case demonstrates the role of taking a careful history and the role of close clinical observation in the diagnosis of corneal ulcers. In milder cases, diagnosis can be made by clinical observation. However, in moderate cases, presentations along the visual axis or situations that do not respond to initial treatment, a corneal culture is necessary. The prognosis is better with earlier diagnosis and treatment. Treatment should be aggressive and can be modified as the ulcer begins to heal. Clinicians must be able to revise treatment if the corneal ulcer does not heal within 24 hours or within an appropriate time frame. Patient noncompliance is an important issue that must be considered not only in prescribing medication but also in refitting the patient with new CLs. Clinicians must educate patients on the potential causes of corneal ulcers, and if they are contact lens wearers stress the importance of not overwearing their CLs. Specifically, clinicians should review lens care

regimens, including recommended replacement schedule, frequent replacement of storage cases, not swimming in CLs, adequate lens disinfection, and avoidance of tap water for cleaning and soaking lenses[7]. Hopefully, with proper patient education and advances in CL technology, materials and solutions, there will be a significant reduction in the number and severity of ulcerative keratitis cases.

Lead Questions for Evaluating Knowledge and Stimulating Discussion

1. Which of the following is the most likely diagnosis based on the patient's presenting symptoms?
   a. corneal ulcer
   b. contact lens-induced acute red eye
   c. primary anterior uveitis
   d. infiltrative keratitis
2. Which of the following is the most likely diagnosis?
   a. fungal keratitis
   b. amoebic keratitis
   c. viral keratitis
   d. bacterial keratitis
   e. primary anterior uveitis
3. Which of the following is most likely associated with this condition?
   a. history of recent trauma
   b. swimming in CLs
   c. improper care of CLs
   d. systemic diagnosis of ulcerative colitis
   e. sleeping in CLs
4. The most appropriate initial treatment option for this patient is:
   a. moxifloxacin 0.5% (Vigamox) one drop every 30 minutes for the first four hours then one drop every hour for the next 18 hours and cyclopentolate 1% (Cyclogyl) bid
   b. prednisolone acetate 1% (Pred Forte) one drop every four hours and cyclopentolate 1% (Cyclogyl) bid
   c. trifluridine 1% (Viroptic) one drop every hour and cyclopentolate 1% (Cyclogyl) bid
   d. natamycin 5% (Natacyn) one drop every hour and cyclopentolate 1% (Cyclogyl) bid
   e. ciprofloxacin 0.3% (Ciloxan) two drops every 15 minutes for six hours, then two drops every 30 minutes for 18 hours and cyclopentolate 1% (Cyclogyl) bid
   f. polymyxin B sulfate/trimethoprim sulfate (Polytrim) one drop every hour and cyclopentolate 1% (Cyclogyl) bid
5. The most appropriate follow-up for this patient is:
   a. 24 hours
   b. 48 hours
   c. 1 week
   d. 3 days
   e. return if symptoms worsen
6. Which of the following is the most likely potential sequel of this patient's condition?
   a. corneal scar
   b. corneal transplant
   c. anterior synechiae
   d. posteriorsynechiae
   e. glaucoma
7. Which of the following is a defense mechanism of the cornea?
   a. tight cellular junctions of the corneal epithelium
   b. corneal endothelial pump
   c. tight cellular junctions of stroma
   d. epithelial regeneration
8. The most common reason for a corneal culture in this case would be:
   a. size of epithelial defect
   b. location of defect
   c. poor response to therapy on follow-up
   d. age of patient
   e. history of CL use
9. Which of the following best describes the pathophysiology of this patient's condition?
   a. increased metabolic stress on the cornea
   b. inability of endothelial pump to remove fluid
   c. tear film instability
   d. hyperosmolarity on the cornea
10. Which of the following is the most likely etiology of this condition?
    a. Fusarium
    b. Acanthamoeba
    c. Pseudomonas
    d. Herpes simplex
    e. Staphylococcus

Answer key: 1(a), 2(d), 3(e), 4(a), 5(a), 6(a), 7(a), 8(c), 9(a), 10(c)

To initiate discussion, "why" each answer was chosen should be elicited from students. Question #4 should involve a discussion of the off-label use of medication.

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