ASSOCIATION of SCHOOLS and COLLEGES of OPTOMETRY

Optometric Education The Journal of the Association of Schools and Colleges of Optometry

Teaching Ocular Imaging, Disease Diagnosis and Management Within a Work-Integrated Setting: a Novel Model Within an Optometric Education Program | 1

By: Jaclyn Chiang, BOptom, MOptom, GradCertOcTher; Paula Katalinic, BOptom, MOptom, GradCertOcTher; Lisa Nivison-Smith, BSc (Hons), PhD, FAAO; Michael Yapp, B.Optom (Hons), M.Optom, GradCertOcTher, FAAO; Barbara Zangerl, PhD, DVM, BSc; Sieu Khuu, BSc (Hons) and PhD; Kathleen Watt, BOptom (Hons); and Michael Kalloniatis, BSc (Optom) MSc (Optom) PhD, GradCertOcTher, FAAO

Introduction

Technological advancements in ocular imaging are rapidly redefining the way eye diseases such as glaucoma and macular degeneration are diagnosed and managed in optometric practice.

In Australia, the scope of practice of optometrists has expanded with the increasing accessibility of advanced imaging technologies as well as therapeutic endorsement of more than 50% of the profession to prescribe scheduled medicines for the treatment of ocular conditions.[1] There are underlying similarities with the scope of practice in other countries. For example, optometrists in the United States are able to perform enhanced primary care procedures such as the use of lasers in certain states.[2] With the expanding scope of practice of optometrists and ocular imaging technology becoming increasingly ubiquitous in optometric practice,[3] optometric educators currently face the challenge of teaching progressively complex material within the time and resource constraints of pre-existing education programs. These constraints are augmented in new or accelerated optometry programs that aim to maximize teaching and learning in a shortened time frame or within a competitive educational environment.[4-8] Consequently, the development of novel teaching models and curricular innovation, both for educating optometry students and upskilling optometrists in clinical practice, have been required to keep pace with these changes.

Specific challenges for optometric educators, community optometrists and optometry students include staying abreast of the plethora of new literature relating to the diagnosis and management of ocular diseases; understanding the application, limitations and interpretation of new imaging technologies such as optical coherence tomography angiography (OCTA); and gaining sufficient hands-on experience using these instruments. Typically, this education for students has taken the form of preclinical and theory-based training followed by clinical examination of patients within college- or university-operated clinics or community-based primary care optometry clinics, or observation-based placements within ophthalmology practices where advanced imaging is conducted by ophthalmic technicians. The length of this practical training varies across optometry programs internationally (average two years in the Australian education system vs. average three years in Doctor of Optometry programs in the United States[9]), but the fundamental goals are the same: to hone students' technical skills and, more importantly, ensure development of the analytical skills necessary to interpret results and render appropriate treatment plans. This is especially critical for current optometric practice where technical elements are increasingly being delegated to technicians.

However, evidence of poor performance in these skill areas by optometrists suggests these placements are not effectively transferring the students' complex theoretical knowledge into clinical skills. For example, Bakkum and Trachimowicz[10] found optometrists in private practice were significantly less likely to correctly identify any of the 10 anatomical layers of the retina compared with optometry students despite this skill being essential for the correct interpretation of OCT images. Similarly, the emergence of "red disease"[1] and "green disease,"[12] pertaining to the misclassification of the presence or absence of pathology by the instrument, indicates the consequences of poor understanding relating to the limitations of each instrument and its normative database in clinical decision-making. Thus, implementing new education approaches to address these challenges is essential. Without sufficient training, an optometrist risks misinterpreting results and mismanaging patients.

The aim of this article is to present a novel, practical model for teaching advanced ocular imaging, disease diagnosis and management within a work-integrated setting. This model is implemented as a six-week placement at the Centre for Eye Health (CFEH) for final-year optometry students of the University of New South Wales (UNSW) Sydney, Australia. Students are fully integrated into the clinical pathway for the delivery of intermediate-tier imaging and visual system diagnostic services to patients with, or at risk of, eye disease. Background information about the model and curriculum structure as well as student outcomes and feedback are provided and discussed.

Teaching Model

Setting: Centre for Eye Health

CFEH is a unique optometry-led collaborative initiative of Guide Dogs NSW/ACT and UNSW Sydney, which has been described previously.[13,14] Briefly, CFEH was established in November 2009 with a mission to reduce preventable blindness by providing diagnostic eye assessments, using state-of-the-art technology, at no cost to patients. CFEH is a referral-only clinic for non-urgent cases and has been validated to reduce unnecessary referrals to ophthalmologists for patients suspected of glaucoma[13] or macular pathology.[14]

Patients presenting to CFEH are a unique cohort who have been identified by their referring optometrist or ophthalmologist as having an ocular abnormality or disease, or being at risk of disease development, but not requiring urgent ophthalmological treatment. Referring practitioners can opt to refer an individual for a comprehensive diagnostic test suite or for imaging tests in isolation. A subset of patients is referred directly to the collaborative care glaucoma clinic, under the oversight of a glaucoma specialist ophthalmologist, for treatment of previously diagnosed glaucoma. Since 2012, CFEH optometrists have examined more than

32,000 demographically diverse patients with the most commonly seen conditions being glaucoma suspect or glaucoma, macular degeneration, other macular pathology, diabetic retinopathy, peripheral retinal degenerations, pigmented lesions or suspected corneal ectasia.

The CFEH clinical team (15 optometrists and a clinical scientist) is responsible for the development, refinement and implementation of CFEH's novel protocols for examining patients, recalling patients to ensure that none is lost to follow-up, and communicating results to co-managing clinicians. Staff optometrists work closely with consultant ophthalmologists from the local public hospital ophthalmology service who provide indirect patient consultations by reviewing images and clinical data collated into a report by the examining optometrists and students. The clinical team is also intrinsically involved in optometric education, providing teaching within the optometry program of UNSW Sydney as well as postgraduate and continuing education for optometrists in clinical practice. Overall, the clinical team has a range of 3-15 years of experience in teaching optometric students.

Curriculum structure

Optometry schools in Australia have adopted various curriculum structures and course lengths ranging from a 3.5-year undergraduate degree, a combined five-year double degree and, most recently, more in line with the United States, a four-year postgraduate OD program. While variation exists among Australian optometric programs, they all essentially consist of at least one year of preclinical training and are followed by at least one year of practical clinical training.

TABLE 1
Curriculum Structure Overview*

Week		Learning/Practical Tasks	Feedback/Assessment	Aims
Prior to placement		View 10, one-hour digital video lectures Review clinically relevant papers		Familiarize with clinically relevant literature
1	Day 1	Two-hour orientation session Interactive demonstration on the technical operation of ocular imaging equipment Practice using equipment	One-on-one feedback	Outline details and expectations of placement Instruct students in the use and analysis of the latest commercially available equipment in ocular imaging Students to demonstrate competency in patient instruction and instrument operation
	Day 2 & Day 3	Observe a minimum of two staff optometrists assessing patients for a total of eight hours Individually obtain images from a minimum of 10 test subjects on each instrument	One-on-one feedback Practical assessment on key instruments at the end of day three	
	Day 4 & Day 5	Perform advanced imaging and functional testing on actual CFEH patients	Direct one-on-one supervision of a staff optometrist Report writing Individual feedback Hurdle test of 30 multiple choice questions on Week 2 Day 10	Provide a hands-on practical component in using ocular imaging to assess patients Provide exposure to ocular disease patient assessment Develop confidence and knowledge in the diagnosis and management of ocular diseases Tests understanding of technical aspects of image interpretation, disease diagnosis and key grading scales
2		Four-hour block of seeing patients either in the morning or afternoon		
3 - 4		'Leapfrog' schedule where students alternate seeing every second patient for the day (eight hours total)	Two-on-one supervision of a staff optometrist Report writing Individual feedback	Maximize efficiency in scheduling of patients Encourage time management and workflow skill development
Throughout the placement		Interactive case studies Problem-based learning cases Weekly grand round lectures Review of past patient records in "interesting cases" database Small group face-to-face tutorials Presentation of critical analysis of emerging literature	Immediate individual feedback with interactive digital learning materials and face-to-face grand round lectures and tutorials	Provide a range of learning materials to create a blended learning experience

* Note: A four-week curriculum was originally implemented where weeks 3 and 4 were not performed.

Table 1. Click to enlarge

With regard to this model, students are enrolled in the combined Bachelor of Optometry/Bachelor of Science undergraduate course at UNSW Sydney, where they undertake a placement at CFEH as a mandatory requirement of the Clinical Ocular Therapy subject during Stage 5 (final year) of the program. **Table 1** gives an overview of the curriculum structure for this placement.

Overall aims of the placement are to improve the students' technical facility relating to advanced imaging modalities and to help them develop appropriate integrative and application skills in using these technologies. Students entering Stage 5 have already completed four years of optometry-specific undergraduate training and are equipped with a sound theoretical knowledge of the anatomy and physiology of the eye, ocular diseases and ocular therapeutics. Students have completed a year of practical hands-on training in the general optometry clinic at UNSW, gaining proficiency in clinical skills such as tonometry, pachymetry, gonioscopy, indirect ophthalmoscopy, funduscopy, and have had some exposure to specialized clinics in areas including contact lens, red eye and color vision.

Prior to beginning their placement, students are required to view 10 one-hour video lectures primarily focused on the differential diagnosis of ocular disease using advanced imaging modalities. They also familiarize themselves with clinically relevant literature related to image interpretation, disease diagnosis and management, and key grading scales such as the AREDS AMD severity scale.[15] Students are scheduled to attend CFEH from 8:30 a.m. to 5 p.m., five days per week, for a total of six weeks. They attend in groups of 8-10 depending upon the total number of students enrolled in that year.

During the first three days, the details of the placement including expectations of professionalism and excellence in patient care delivery and the novel CFEH patient care pathway[13,14] are outlined to the students. Referral forms and clinical protocols are discussed, and navigation of the customized electronic medical record system (VIP.net, Houston Medical) is demonstrated. The technical aspects of the imaging technologies are demonstrated using an apprenticeship approach. Students familiarize themselves with instrument operation and testing protocols through observing and interacting with supervising optometrists. The range of instruments includes Cirrus OCT (Zeiss), Spectralis OCT (Heidelberg), HRT3 (Heidelberg), Pentacam HR (Oculus), WX 3D non-mydriatic stereo photography (Kowa), Optomap 200TX widefield imaging (Optos), E300 corneal topography (Medmont), IRX3 wavefront aberrometry (Imagine Eyes), Retinomax autorefraction, automated blood pressure measurement, and Humphrey visual field analysis. Instruction is provided on downloading images and reports from the instruments and importing them into the corresponding medical record, with the specific combination of images and/or reports tailored to the referral type and the number of previous visits. Orientation is concluded with a hurdle practical assessment to confirm student competency in providing clear and empathetic patient instructions, operating the instruments, troubleshooting image artifacts and technological issues, and obtaining high-quality images.

TABLE 2
Teaching Methodologies Used Within the CFEH Placement

Teaching Methodology	Description
Observation and practice (Apprenticeship approach)	• Observe, remember and understand the technical operation of instruments demonstrated by clinical staff • Apply and refine skills of operating equipment and assessing patients
Digital material (Blended teaching)	• 10 one-hour video lectures produced by clinical staff (e.g., "When macula disease is not age-related macular degeneration" and "When does a glaucoma suspect convert to glaucoma?") • 68 interactive case studies created by clinical staff • CFEH "interesting cases" database with more than 2,500 patients categorized into different areas of pathology such as macula, glaucoma, optic nerve
Face-to-face learning (Blended teaching)	• Problem-based learning case studies discussion with clinical staff • Weekly interactive grand round lecture presentations by clinical staff • Small group tutorials with "rapid-fire" question and answer sessions
Team presentation (Blended teaching)	• Students work in pairs to present critical analysis of a current research paper in optometric literature to clinical staff followed by question and answer session
Higher-order thinking	• Develop trouble-shooting skills for problems arising while examining patients • Analyze and evaluate clinical test results to create a suitable report
Reflective practice	• Reflecting on learning experiences from each case • One-to-one discussion with supervising optometrist

Table 2. Click to enlarge

For the remainder of their placement, students perform advanced imaging and a range of functional testing on patients under the direct supervision of a staff optometrist. In a manner typical of fieldwork placements in other health professions,[16] staff optometrists play an educative, supportive and administrative role in supervising students throughout the placement. Contact procedures (gonioscopy, ultrasonic pachymetry and applanation tonometry), funduscopy and ophthalmoscopy are performed by the staff optometrists. Students are offered the opportunity to examine patients with these techniques where it is deemed likely to further their understanding of the ocular pathology.

Following each patient assessment, students import relevant images and reports into the patient's medical record. Using custom report templates **(Appendix A)** students analyze the results of the patient consultation, list differential diagnoses, propose a diagnosis, discuss a suitable management plan, and reflect on the lessons garnered from the case. Student reports must be submitted within two days to the supervising optometrist (to simulate a true work environment) and individualized written feedback is provided. Final patient reports are written by supervising optometrists and co-signed by a second optometrist or a consultant ophthalmologist, as an additional means of quality control. Students are encouraged to review final reports to complete their learning experience. By the end of the placement, students have been exposed to a wide range of teaching strategies. **(Table 2)**

Student Outcomes

Student outcomes from the model were assessed from its implementation in 2014 to the end of 2016. Quantitative data included analysis of students' patient exposure and student feedback via a paper-based survey. Qualitative data were collected informally through discussion with supervisors and an open-ended comments section in the student survey. Note that there was a change in the curriculum described in Table 1 between 2016 and the previous years where weeks five and six were not performed because students were available only for a four-week period.

Number of patients seen

Individual students, on average, examined 88 patients during a six-week placement at CFEH. As CFEH is a referral-based centre, most patients had signs of ocular disease or were 'non-textbook' cases of diseases. Examinations lasted 30 minutes to two hours per patient and included the opportunity to conduct multiple tests, e.g., students conducting a glaucoma assessment performed visual acuity measurement, autorefraction, blood pressure measurement and Humphrey 24-2 perimetry, obtained retinal photographs, OCT and HRT3 images and assisted with patient history, tonometry, gonioscopy, pachymetry, funduscopy and slit lamp examination. The application of multiple teaching strategies **(Table 2)** meant students were also potentially exposed to a further 550 cases through peer discussions, tutorials, interactive case studies, digital video lectures, problem-based learning cases, grand rounds lectures presented by staff, and review of patient records.

Views from student supervisors

Informal discussions with supervising optometrists were used to determine impressions of student performance within the work-integrated student teaching model. Supervising clinicians commonly noted that student skills relating to the technical aspects of using advanced imaging devices improved over the course of placement. Examples of this improvement included fewer instances of images needing to be retaken by the supervisor or student due to poor quality and an overall reduction in the time taken to acquire images at later stages of the placement. Clinical skills relating to image interpretation and differential diagnosis were also reported to be improved. Specifically, supervising optometrists observed that students developed a greater understanding of how to recognize image artifacts, interpret results from patients who have anatomical or demographic features that fall outside the instrument-based normative database, and provide a cohesive diagnosis and management plan based on their patient reports.

Student survey results

Formal student feedback was collected through a 15-question survey at the end of each placement. Students were asked to rate the level of agreement that most accurately reflected their opinion on a 5-point Likert scale ranging from strongly agree (5) to strongly disagree (1). A summary of the results is provided in **Table 3**. An optional written comments section was also provided. Examples of student quotations are shown in **Table 4**.

TABLE 3
Student Survey Results

	2014 n=78	2015 n=65	2016 n=40	Average
Non-cognitive factors				
1. The CFEH clinical rotation helped motivate me to learn	4.5	4.7	4.9	4.7
2. The hands-on CFEH clinical rotation was useful in helping me improve my clinical confidence and understanding of testing protocols	4.4	4.8	4.9	4.7
Assessment methods				
3. I received helpful feedback on how I was doing in the CFEH clinical rotation	4.1	4.3	4.7	4.4
4. I found writing the CFEH patient summary reports helpful	4.2	4.5	4.6	4.4
Teaching methodologies				
5. The tutorials held during the rotation were useful both for clinical knowledge and the CFEH rotation itself	N/A	4.7	5.0	4.9
6. The course materials provided for the CFEH clinical rotation were useful (podcasts, problem-based learning cases, etc.)	4.4	4.8	5.0	4.7
7. The CFEH teaching staff showed an interest in the needs of the students	4.7	4.6	4.8	4.7
8. I found the CFEH clinical update presentations useful (Tuesday lunchtime)	4.4	4.5	4.8	4.6
9. The volume of work in the CFEH clinical rotation was appropriate	3.2	4.0	4.4	3.9
Learning outcomes				
10. The CFEH clinical rotation was useful in helping me improve my differential diagnostic capabilities	4.3	4.7	4.9	4.6
11. The CFEH clinical rotation improved my knowledge and understanding of the role and interpretation of ocular imaging and other diagnostic tests	4.7	4.9	4.9	4.8
12. The CFEH clinical rotation helped deepen my understanding of ocular disease diagnosis and management	4.3	4.8	4.9	4.7
13. I had a clear understanding of what was expected of me in the CFEH clinical rotation	4.3	4.5	4.6	4.5
Satisfaction				
14. Overall, I was satisfied with the quality of the CFEH clinical rotation	4.4	4.8	4.9	4.7
15. Overall, I was satisfied with experience provided during the CFEH clinical rotation	4.5	4.8	5.0	4.8
Average score over all aspects	**4.3**	**4.6**	**4.8**	**4.6**

Each question was answered on a 5-point Likert scale. Numbers represent the average score where strongly disagree = 1; disagree = 2; neutral = 3; agree = 4; and strongly agree = 5

Table 3. Click to enlarge

A total of 183 students across the three years (2014-2016) participated in the survey, which had a 100% response rate. Overall, an average of 4.6 out of 5 (strongly agree) was achieved for all aspects of the students' rotation at CFEH with a notable improvement in the survey scores across all aspects in each successive year. Students showed strong motivation to learn and rated the clinical rotation highly in assisting improvements in clinical confidence and understanding testing protocols (average score of 4.7 out of 5). Cultivation of non-cognitive factors such as self-learning, motivation and embracing challenges was also commonly noted by students in written comments (11 out of 53 comments).

TABLE 4
Examples of Student Written Feedback

1. General comments	- I enjoyed the rotation and learned a lot - made me more knowledgeable and concise - I found all components of the course very helpful - I think I would have had a better learning experience if I was placed at the start of the semester rather than the end
2. Non-cognitive factors	- … I gained a lot of confidence in terms of imaging and management - … made me feel motivated to be a better clinician - … I was always extremely motivated to learn and study
3. Assessment methods	- Too many reports at times … - I had trouble keeping up with the work load due to having lots of assignments due from other courses - Summary reports were very helpful, however there was a stage of struggle with the work load (not a fault of CFEH rotation, but rather everything was due at the end of the rotation) - … initial days practicing with the machines helped us with confidence, professionalism and interpretation of results
4. Teaching methodologies	- PBLs were great for learning and staff were enthusiastic to teach and help - Tutorials were some of the best learning experiences. Maybe a quick MCQ occasionally would be good - … it's good that we got 1 on 1 feedback … - The staff really catered to our needs and inspired to help us learn - Having more one on one time with supervisors to answer questions - … Perhaps more PBLs. Learn most from these (PBLs) and clinical updates - Clinical updates (in particular the webinars) were very useful and broadened my knowledge. They provided good review and reiterated/filled any gaps in our knowledge
5. Learning outcomes	- Loved it! It really improved my knowledge on ocular diseases - … It has definitely helped to build my knowledge of the imaging machines and how to interpret them

Comments were analyzed for common themes and grouped as general comments, comments on non-cognitive factors, assessment methods, teaching methodologies and learning outcomes

PBL = problem-based learning case; MCQ = multiple-choice question

Table 4. Click to enlarge

In terms of teaching methodologies, the tutorials were most highly rated, followed by the course materials and quality of the teaching staff. **(Table 3)** Summary reports and feedback were also helpful, achieving a score of 4.4 out of 5 each. Written comments regarding teaching methodologies also indicated that students valued face-to-face interaction with their supervisors such as in tutorials, discussions of problem-based learning cases, individual feedback and weekly grand round lectures and clinical update meetings presented by staff. **(Table 4)** The appropriateness of the volume of work was rated the lowest (3.9 out of 5) with a number of written comments about the work load being too high (8 out of 53 comments). Forty percent of these comments, however, clarified that high work load was due to other assignments being due during the placement. Overall, survey scores and comments indicated students' perception of the placement was useful, helpful and enjoyable with students gaining confidence in ocular imaging and being motivated to learn.

Clinical efficiency outcomes

Figure 1 depicts the number of patients examined per equivalent full-time (EFT) staff optometrist at CFEH before and following student model implementation. Prior to student integration, the two-year average was 673 patients/EFT optometrist. This was improved to 901 (134% increase) and 980 (146% increase) with the introduction of the four- and six-week placements respectively. This increase in efficiency was achieved in combination with scheduling changes that were allowed by the availability of students to participate in patient management. As students became more efficient in their technical skills, an initial one-on-one supervision was replaced by two-on-one supervision of a staff optometrist, which optimized staff and time resources within the clinic.

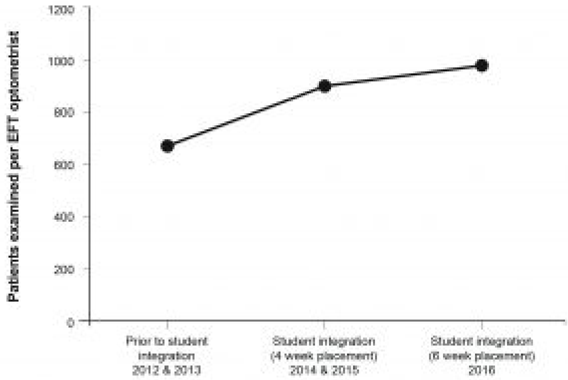

Figure 1. Number of patients seen per equivalent full-time (EFT) staff optometrist at the Centre for Eye Health prior to and following implementation of the teaching model. Click to enlarge

Discussion

The rapidly changing scope of optometric practice due to advances in ocular imaging technology means increasingly complex competencies are now required from optometrists.[17] Australian optometric education is constantly evolving in response to the expanding scope of practice, in particular the incorporation of advanced technology and prescribing of therapeutic agents,[1,17] as well as a changing educational landscape from the traditional mode of classroom teaching and learning to more flexible, self-directed, blended teaching and learning modalities. The challenge for optometric educators is to efficiently and effectively develop and deliver this material and provide students an environment where they can apply and translate their textbook knowledge to practical skills and learn to troubleshoot when challenges arise. At the same time, efficient use of clinic time and resources is required due to central fiscal demand. Here, we have described a successful, work-integrated teaching model enhanced by a range of teaching methodologies, where final-year students are intensively integrated into the clinical pathway within a unique workplace setting for six weeks. A discussion of the advantages and disadvantages of the model follow.

The model appears highly effective for teaching complex materials such as advanced ocular imaging and diagnosis

The advantages of work-integrated learning are well-established and include promotion of knowledge development, professional attitudes and communication.[18] For example, community-based optometric placements have been successful in providing students with a broad range of experiences,[19] promoting cultural competency[20] and community outreach.[21] These placements also address entry-level competency standards for the profession of optometry in Australia,[17] and similarly the New Professional Optometric Degree Standards as outlined by the Accreditation Council on Optometric Education (ACOE)[22] by providing a platform for students to consolidate, integrate and apply their theoretical knowledge, hence ensuring essential clinical experience and competency to "independently practice contemporary optometry." The resource-intense nature of placements, however, is often cited as a limitation to implementing and extending these activities in curricula.[20,23] Consequently, many placements utilize an observation-based approach, which limits the quantity, quality and variety of student interaction and practical skill development.

In this model, although a resource-intense training period of three days was required at the beginning of the placement, the use of a range of teaching methodologies, direct involvement of students in patient care, and examination of a high volume of patients all seemed to be useful in promoting self-directed learning among students and reducing the teaching and resource load during the remainder of the placement. This may be of particular use to new or accelerated optometric programs that are faced with the additional challenges of developing sustainable clinical placement programs within a competitive educational space and shortened time frame. Examples of such programs offered in optometry schools include the 3.5-year undergraduate degree at Deakin University in Victoria, Australia, and the 36-month Accelerated Scholar's Program at Pennsylvania College of Optometry at Salus University in the United States, which emphasize early clinical exposure and extended clinical placements to allow students to continuously build on their clinical skills. However, specific challenges associated with an accelerated model in Australia include recruiting practices that are adequately equipped to accommodate students and overcoming clinic inefficiencies of students slowing down appointments.[4] In particular among Australian optometrists, there is moderate support for extended clinical placement programs. The burden on time and decrease in number of patients examined are the top perceived disadvantages.[24] The CFEH model design led to outcomes that were beneficial for both the student and workplace, overcoming most of the challenges and perceived disadvantages of clinical placements.[4,24] Student feedback indicated development of practical capabilities for using, interpreting and applying results from diagnostic imaging technologies within the six-week time frame. Concurrently, student integration allowed for greater service delivery by the clinic. Considering that the ability to interpret and apply results from diagnostic imaging technologies is now considered an entry-level competency by the main professional body for optometrists in Australia,[17] this model demonstrates usefulness towards efficiency in learning these technologies.

The model promoted skills associated with lifelong learning, essential in the optometric profession

Optometry students are required, at a minimum, to attain a competent level of professionalism before they can enter the workforce, whereby they are able to consciously interpret available data and adjust management plans for specific patients or clinical situations. Optometry Australia, the leading professional body, has published detailed entry-level competency standards.[17] Among a range of professional responsibilities, the ability to "continue to expand and update skills and knowledge for safe and evidence-based practice through adoption of a lifelong approach to learning" is deemed essential. The importance of embracing research and evidence-based practice and prioritizing these elements in curricular planning within schools and colleges of optometry has also been highlighted.[25] Student survey results indicated this teaching model promoted non-cognitive skills associated with critical reflection, self-learning and motivation, factors known to be essential to students' success beyond university as they embark on their careers[25,26] and in alignment with Faucher's[27] description of professional expertise development.

Raising the standards of new graduates may have a beneficial flow-on effect of contributing to the prevention and reduction of eye diseases within the community. Furthermore, the uniqueness of this optometry-led clinic, its patient cohort and highly skilled optometric staff with a dedicated interest in diagnosis and management of ocular diseases also provides an adaptive learning environment. This environment and the ability to diagnose and manage eye disease more confidently, particularly in light of the increasing scope of optometric practice, could translate to improved career satisfaction when combined with effective programs to upskill the profession and train new graduates.

Student outcomes from this model were used to guide, refine and implement improvements and changes to the teaching methodologies and content

Student surveys and feedback were an important element in guiding and refining the teaching methodologies and materials with enhancements made to the instructional delivery and content. Such changes have resulted in improvements to the student survey scores across all aspects in each successive year. **(Table 3)** As students indicated that they valued face-to-face interactions, teaching methodologies were refined to place an emphasis on delivering these learning opportunities such as the implementation of weekly grand round lectures, tutorials and discussions of problem-based learning cases. Clinical update meetings and grand rounds-style lectures were also modified from a lecture mode presented by staff to "rapid-fire" question and answer sessions, resulting in greater student participation and interaction with their supervisors, as well as cultivating higher-order thinking. Tutorials were also updated to concentrate on areas where students showed the weakest knowledge based on student-supervisor discussions, performances on their hurdle test of 30 multiple-choice questions (MCQs), and other clinical performances such as communication, report writing and analyzing results, addressing both technical and, more importantly, analytical skills with an emphasis on management and diagnosis. Another aspect measured was volume of work, which garnered the lowest survey scores, although this was possibly confounded by other assignments that were due at the same time. Based on such feedback, report templates were streamlined to adjust the volume of work. This resulted in an improvement of survey scores from 3.2 to 4.4 out of 5, with summary report templates implemented at the final two weeks of the program. These summary report templates encouraged students to integrate relevant results in constructing a concise report and allowed clinical supervisors to prioritize students who needed more guidance in analyzing and integrating results. As evaluating teaching and learning methods are an important responsibility among education providers to ensure delivery of quality teaching and optimize student learning,[28-32] this model has measured outcomes using strategies such as student surveys and feedback as well as supervisor impressions. These methods have shown to be useful in refining teaching methodologies and content, as demonstrated by an increase in student satisfaction scores, and can be implemented in a variety of clinical settings to evaluate the effectiveness of teaching strategies and materials and to guide refinements.

This model may be enhanced by the integration of technological solutions to optimize clinical efficiency and extend the student learning experience

We acknowledge that areas within the current model may be improved by implementing technological solutions to transform current manual procedures and optimize the use of resources, in turn enhancing the student learning experience and creating a sustainable learning environment. Specifically, the use of tracking software such as Meditrek (Morrisville, Pa.) to capture the clinical supervisors' impressions of the progress of students will allow for more quantitative analysis of such information. Other enhancements that can be implemented include an electronic portfolio with the potential to allow students and supervisors to track their learning and competencies, expand feedback and interaction modalities, and build learning communities by enabling questions and case discussion with peers and supervisors via a digital platform. As teaching procedural and operational skills related to a vast range of ocular imaging equipment can place considerable burden on time and staff resources, digitizing certain aspects of instructional delivery may be beneficial. For example, instrument demonstration videos disseminated to and completed by students prior to their placement may be useful in allowing flexible, self-directed learning and optimizing use of face-to-face time with supervisors over the orientation period to refine techniques, discuss difficulties and learn to troubleshoot when problems arise. Such enhancements may be implemented in a variety of clinical placements requiring tracking of student-supervisor interaction, competency-based teaching and flexibility of the learning environment.

This model may be limited by the specific scope of the workplace environment

A potential limitation of this teaching model is the workplace setting: CFEH is an optometry-led, referral-only clinic for patients who have or are suspected of having ocular disease. The clinic is also based at a teaching and research institution and therefore staff knowledge is highly specialized and current with specific continuing education practices embedded within the workplace. We acknowledge that most optometry-driven clinics may not operate under such specific clinical protocols. However, most optometry education programs throughout the world are likely to include placements at clinics that utilize advanced ocular imaging technologies and have unique clinical pathways. For example, in most U.S. colleges, students undergo externships at various ocular disease specialty clinics during the final year of the program[9] such as those offered by Nova Southeastern University.[33] In the United Kingdom, observation-based clinical placements at the Moorfields Eye Hospital are offered by the City University of London.[34] In this case, strategies used within the model, specifically the full integration of students into the workplace to perform service delivery and patient management with advanced imaging and the use of a variety of teaching methodologies should be applicable to a wide range of other clinical settings and contribute to positive outcomes such as those seen in this placement.

Conclusion

This article highlights the potential benefits of intensively integrating optometry students into a unique workplace environment dedicated to advanced ocular imaging and disease management. Survey results collated over three years show increasingly positive feedback from students in regard to various aspects of the model and cultivation of higher-order thinking and non-cognitive factors. The model also shows benefit to the workplace through improved efficiency in service delivery. Considering the increasing level of theoretical knowledge that needs to be taught to optometry students and the consequent pressure this places on finding opportunities to translate the knowledge into practical skills, models such as this may represent efficient methods of addressing these challenges.

References

1. Kiely PM, Cappuccio S, McIntyre E. Optometry Australia Scope of Practice Survey 2015. Clin Exp Optom. 2017;100(3):260-269.
2. Hepp R. Scope of practice battle rages in NC. Review of Optometry. 2017:154(3):4.
3. Ly A, Nivison-Smith L, Zangerl B, Assaad N, Kalloniatis M. Self-reported optometric practise patterns in age-related macular degeneration. Clin Exp Optom. 2017 Nov;100(6):718-728.
4. Weisinger HS, Prideaux D. Modernizing optometric education in Australia: ideas from medical education. Optometric Education. 2011;37(1):28-35.
5. Wang-Harris S. Optometric education in Trinidad and Tobago: developing a new program in the West Indies. Optometric Education. 2013;39(1):20-27.
6. Loughman J, Chan VF, Moodley VR, Bilotto L, Naidoo K. Student educational background, perceptions and expectations towards optometry: an emerging eye health profession

Mozambique. Optometric Education. 2015;40(2):104-109.
7. Nehmad L, Appel J. The integrative track at SUNY State College of Optometry. Optometric Education. 2011;36(3):146-151.
8. Pennsylvania College of Optometry Accelerated Scholars Program. Accessed: 10 May 2017. Available from:
http://www.salus.edu/Colleges/Optometry-(1)/Doctor-of-Optometry-%E2%80%93-Accelerated-Scholars-Program.aspx.
9. Association of Schools and Colleges of Optometry (ASCO) Admissions Requirements Handbook. Accessed: 10 May 2017. Available from:
https://optometriceducation.org/wp-content/uploads/2013/08/ASCO-Admission-Requirements-Handbook-2013.pdf.
10. Bakkum BW, Trachimowicz RA. Retention of knowledge of retinal microanatomy by optometric students, faculty and practitioners. Optometric Education. 2015;40(2):77-82.
11. Chong GT, Lee RK. Glaucoma versus red disease: imaging and glaucoma diagnosis. Curr Opin Ophthalmol. 2012;23(2):79-88.
12. Sayed MS, Margolisa M, Lee RK. Green disease in optical coherence tomography diagnosis of glaucoma. Curr Opin Ophthalmol. 2017;28(2):139-153.
13. Jamous KF, Kalloniatis M, Hennessy MP, Agar A, Hayen A, Zangerl B. Clinical model assisting with the collaborative care of glaucoma patients and suspects. Clin Exp Ophthalmol. 2015;43(4):308-319.
14. Ly A, Nivison-Smith L, Hennessy MP, Kalloniatis M. Collaborative care of non-urgent macular disease: a study of inter-optometric referrals. Ophthalmic Physiol Opt. 2016;36(6):632-642.
15. Age-Related Eye Disease Study Research Group. A simplified severity scale for age-related macular degeneration: AREDS Report No. 18. Arch Ophthalmol. 2005;123(11):1570-1574.
16. Stagnitti K, Schoo A, Welch D. Clinical and fieldwork placement in the health professions, page 164. Oxford University Press, Australia and New Zealand; 2010.
17. Kiely P, Slater J. Optometry Australia entry-level competency standards for optometry. Clin Exp Optom. 2015;98(1):65-89.
18. Ferns S, Moore K. Assessing student outcomes in fieldwork placements. Asia-Pacific Journal of Cooperative Education. 2012;13(4):207-224.
19. Wilson R, Sharda V. History of community health center affiliations with the New England College of Optometry. Optometry. 2008;79(10):594-602.
20. Truong M, Bentley S, Napper GA, Guest DJ, Anjou MD. How Australian and New Zealand schools of optometry prepare students for culturally competent practice. Clin Exp Optom. 2014;97(6):540-549.
21. Davis JG. In clinical optometric education, does extern outreach training produce outreach providers? Optometric Education. 2011;37(1):22-27.
22. Professional Optometric Degree Standards. American Optometric Association. Accessed: 10 May 2017. Available from:

https://www.aoa.org/Documents/students/od_manual_08_2014.pdf.
23. Billett S. Curriculum and pedagogic bases for effectively integrating practice-based experiences. Final Report. Sydney, Australia: ALTC; 2011.
24. Bentley SA, Cartledge A, Guest DJ, Cappuccio S, Woods CA. Practitioner perspectives on extended clinical placement programs in optometry. Clin Exp Optom. 2016;99(3):248-257.
25. Adams AJ. The role of research, evidence and education in optometry: a perspective. Clin Exp Optom. 2007;90(4):232-237.
26. Nagaoka J, Farrington CA, Roderick M, Allensworth E, Keyes TS, Johnson DW, Beechum NO. Readiness for college: the role of noncognitive factors and context. Voices in Urban Education 2013. Accessed: 10 January 2017. Available from: https://consortium.uchicago.edu/publications/readiness-college-role-noncognitive-factors-and-context.
27. Faucher C. Development of professional expertise in optometry. Optometry. 2011;82(4):218-223.
28. Irby D, Rakestraw P. Evaluating clinical teaching in medicine. Acad Med. 1981;56(3):181-186.
29. Ramsey PG, Gillmore GM, Irby DM. Evaluating clinical teaching in the medicine clerkship: relationship of instructor experience and training setting to ratings of teaching effectiveness. J Gen Intern Med. 1988;3(4):351-355.
30. Beckman TJ, Ghosh AK, Cook DA, Erwin PJ, Mandrekar JN. How reliable are assessments of clinical teaching? A review of the published instruments. J Gen Intern Med. 2004;19(9):971-977.
31. Beckman TJ, Lee MC, Mandrekar JN. A comparison of clinical teaching evaluations by resident and peer physicians. Med Teach. 2004;26(4):321-325.
32. Snell L, Tallett S, Haist S, et al. A review of the evaluation of clinical teaching: new perspectives and challenges. Med Educ. 2000;34(10):862-70.
33. Nova Southeastern University College of Optometry. Doctor of Optometry Program. Externship Site List. Accessed: 10 May 2017. Available from: https://optometry.nova.edu/od/externships/sites.html.
34. City University of London Undergraduate Optometry Course. Accessed: 10 May 2017. Available from: http://www.city.ac.uk/courses/undergraduate/optometry.

Appendix A

Centre for Eye Health Glaucoma Suite Student Report Template

Glaucoma Suite

Supervisor:

Student name:
Date patient seen:
Patient name and ID:

Disc appearance **(Kowa stereo photos)**	Disc size, shape, orientation: NRR: PPA: Drance: RNFL:	Disc size, shape, orientation: NRR: PPA: Drance: RNFL:
Cirrus Is there asymmetry or areas of reduction? Is this relevant to glaucoma? Why/why not? Is the segmentation correct?		
Spectralis Are the any notable areas of anomalies in retinal architecture?		
HRT3 Does the color disc profile match the stereo disc appearance? MRA sectors flagged – does this correlate with other findings?		
Visual fields Are the fields reliable? Describe defects? Is this relevant to glaucoma?		
Case summary	Glaucoma specific historical risk profile? IOPs and pachymetry within norms/high/low/thick/thin? Angles open/narrow? Evidence of secondary glaucoma risk factors? Do the NRR appearance, imaging and visual fields correlate? If yes, what are the correlating features?	
Diagnosis and differentials **(consider conditions other than glaucoma)**	Diagnosis Differential diagnoses	
Management		
What have you learned from this case? **In terms of the two major areas:** **1. Patient interaction** **2. Clinical case** **(write 1 point each)**		
Supervising optometrist's comments		

NRR = neuroretinal rim; PPA = peripapillary atrophy; MRA = Moorfields regression analysis; RNFL = retinal nerve fiber layer

ASSOCIATION of SCHOOLS and COLLEGES of OPTOMETRY

Optometric Education The Journal of the Association of Schools and Colleges of Optometry

Teaching Ocular Imaging, Disease Diagnosis and Management Within a Work-Integrated Setting: a Novel Model Within an Optometric Education Program | 18

Click to enlarge

Follow

Share