

# A Novel Approach to Bridge the Gap Between Didactic and Clinical Education

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## Abstract

**Purpose:** Primary Care Conference is a hybrid project-based approach to learning that utilizes clinical cases to help bridge the gap between what happens in the classroom and the expectations of clinical performance.

**Methods:** Timed and image-rich clinical cases are presented to students via a learning management system and then later in class with discussion.

**Discussion:** Primary Care Conference provides benefits to both students and faculty members.

**Outcomes:** These cases appear to assist with clinical thinking development.

**Conclusions:** Primary Care Conference is a novel format that provides the benefits of problem-based learning but in a large class setting.

**Key Words:** learner-centered, problem-based learning, critical thinking

## Background

Traditional problem-based learning (PBL) is a learner-centered educational pedagogy in which students learn through the experience of problem-solving in small collaborative groups. The teacher acts as a facilitator to guide students in their self-directed learning rather than as lecturer providing content. During the process, students identify deficiencies in their own knowledge base, acquire new knowledge, and apply the new knowledge to the problem. Because the student is managing his/her own learning goals, he/she is developing skills needed for lifelong learning.<sup>1,2</sup> This is in stark contrast to traditional teaching and learning, which is often lecture-based. PBL was originally developed for medical schools by Howard Barrow and his colleagues at McMaster University. Barrow's taxonomy reflects a spectrum of PBL based on the amount of self-directed learning and problem structure. True PBL requires students to use a high degree of self-directed learning and solve ill-structured problems, those without a single correct solution. On the spectrum of PBL are hybrid models, such as project-based learning, that use a more well-structured case where learning is partially self-directed and partially instructor-led in small groups.<sup>3,4</sup>

The goals of PBL in optometry school are to develop knowledge that is adaptable to a variety of clinical presentations, effective problem-solving skills, self-directed learning and intrinsic motivation. Unfortunately, traditional problem-based learning is faculty intensive with one faculty member instructing a small group of students. This can act as a financial burden on the institution and prohibits its widespread adoption.<sup>5,6</sup> The Illinois College of Optometry (ICO) has developed Primary Care Conference (PCC), a didactic course to supplement third-year clinical patient care, which takes a novel approach by allowing a single instructor to act as a facilitator for a class size exceeding 150 students. The purpose of developing PCC is to provide our students with the benefits of PBL in a large class setting. Additionally, PCC offers many benefits to participating faculty by offering experience as a lecturer and improving their skills as clinical preceptors.

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Primary Care Conference is a hybrid project-based approach to learning that utilizes well-structured clinical cases to help bridge the gap between what happens in the classroom and the expectations of clinical performance. Much like traditional PBL, PCC uses a learner-centered method of teaching where students are asked to solve cases independently. This type of self-directed education fosters lifelong learning and develops clinical thinking.<sup>7</sup> The clinical cases help students to identify their weak areas and promote independent research of these topics. The students develop their clinical reasoning by attempting to solve the cases by applying knowledge from their didactic coursework.

## Methods

Every academic quarter in PCC, the third-year students at ICO are provided with multiple clinical cases that are followed by a series of 6-7 questions. A clinical faculty member writes each image-rich case, provides case questions and leads an in-class discussion.

### Faculty

Clinical faculty are approached by the PCC coordinator 2-4 months in advance to request their participation in PCC. Once they agree, they are scheduled a specific date for their case, and a topic is chosen. Based on their presentation date, deadlines for submission are established. Sixteen faculty members each present one case during the academic year with four cases delivered every academic quarter. Faculty are deliberately chosen from a variety of subspecialty areas to ensure selection of a broad range of clinical case types. Although the specific cases and order of presentation will vary with each academic year, it is desirable for students to experience as many different case types as possible with minimum repetition. **Table 1** lists the various case types that are typically targeted.

### Cases

The clinical case information is presented using the National Board of Examiners in Optometry (NBEO) Part II format (**Figure 1**). The template for this format is available for download at [http://www.optometry.org/part\\_2\\_pam.cfm](http://www.optometry.org/part_2_pam.cfm).

Most of the cases are based on actual Ill-

inois Eye Institute patients and generally include refractive and ocular or systemic health components. The NBEO template includes a comprehensive case history following the standard history of present illness (HPI) format. Additionally, a complete review of systems is included. The examination data vary from case to case; however, all the elements of the NBEO template are included regardless of the relevance. It is common to include additional template elements to present a thorough clinical scenario.

Each case must contain images, but the number varies depending on the topic(s) being covered. For example, the sample glaucoma case presented within this paper includes optic nerve photos and visual fields. When photos are included, the description of the structure is omitted so that the student has to make the assessment.

The authoring faculty submits the completed case to the PCC coordinator for an initial review. The coordinator makes edits as necessary to further refine the case. The case is often presented to a third faculty member for additional input. Frequently, the four faculty presenting in a given academic quarter are the ones involved in the editing process. The participating faculty serve as a “mini-committee” to ensure the quality of the cases. Additionally, this review process assists in producing multiple choice questions that are error-free.

### Questions

The cases are selected specifically to challenge the student’s ability to analyze complex clinical data. Based on the case data, 12-14 multiple choice questions are generated. (**Figures 2 and 3**) If the multiple response question format is used, no indication is given to the student as to how many options are correct. The question is simply labeled “Select All that Apply.” Two to three of the 12-14 questions are aimed at reviewing straightforward information previously presented in the didactic curriculum in the given clinical context. These straightforward questions will have partnered questions that are more complex and aimed at requiring the student to consider special circumstances and use an enhanced level of clinical decision-making. Simple fact

recall questions are avoided in favor of questions that require data assimilation. The question topics cover procedural skills, expected data, differential diagnoses, diagnoses, treatment and management, clinically applicable basic science, billing-coding, etc. Frequently, the case author includes questions that emphasize topics that tend to confound students regularly in clinic. After the questions are finalized, they are divided into two groups based on level of difficulty. One group will be presented on the learning management system (LMS) and the other group will be presented in class.

### Case presentation: learning management system version

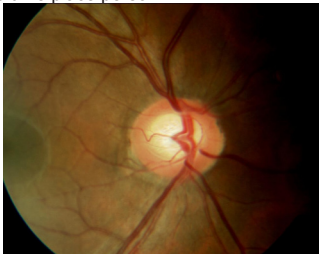
The finalized case along with the 6-7 lower-level questions is posted to the LMS. The students are notified via e-mail that the case is available for completion. Each case is timed. During the first academic quarter of the third year, the students have 16 minutes to complete the case. The time is reduced by 2 minutes each subsequent quarter with a final time of 10 minutes during the final quarter of the third year. The students are allowed to use reference material while completing the case; however, they are encouraged to work independently. Upon completion of the case, the students are shown their score and allowed to review the case. They are shown the correct responses but no justification is given for the correct answers. The onus is on the student to investigate and fully understand the reasoning behind the answers to the questions, which will ultimately assist with completing the in-class portion of the case. The case posted to the LMS is set to close the morning of the in-class case presentation date. The LMS case is not a required component of PCC but instead a highly recommended component, and thus the scores achieved on the LMS case do not contribute to the final PCC grade.

### Case presentation: in-class version

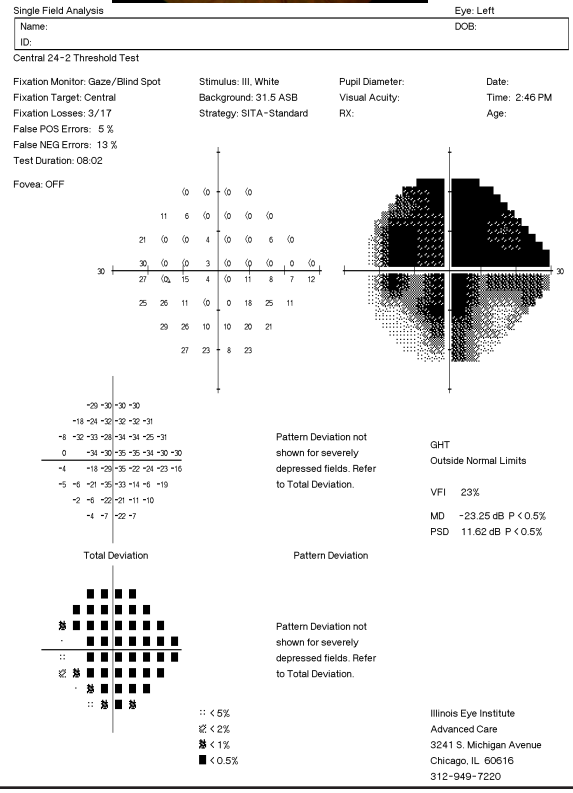
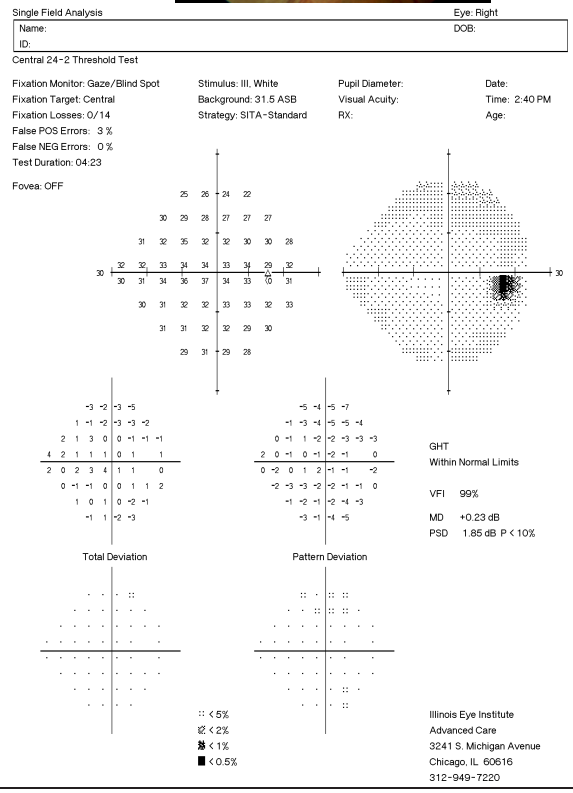
The same finalized case is printed in color with the remaining 6-7 higher level questions. The case is distributed in class following the standard examination protocol (assigned seating and pre-labeled Scantron forms). The students are allowed to begin the case

**Figure 1**  
**The Case Information Posted to the Learning Management System**  
**and Printed for the In-Class Version of the Case**

**Demographics:**  
 42-year-old African American male; curator of Chicago Art Institute  
**Chief complaint:** blurry vision  
**History of present illness:**  
**Character/signs/symptoms:** near blur  
**Location:** OD<OS  
**Severity:** moderate  
**Nature of onset:** gradual  
**Duration:** past two years  
**Frequency:** every day  
**Exacerbations/remissions:** none  
**Relationship to activity or function:** noticed when reading the newspaper  
**Accompanying signs/symptoms:** none  
**Secondary complaints/symptoms:** left eye doesn't see as well as right at distance  
**Patient ocular history:** blunt trauma OS x 20 years ago; no surgeries; herpetic eye infection doesn't remember which eye x 3 years ago  
**Patient medical history:** hypertension x 4 years ago, BP average 140/80  
**Medications:** "water pill"  
**Patient allergy history:** sulfa  
**Family ocular history:** father has GLC and cataracts  
**Family medical history:** mother has HTN  
**Review of systems:**  
**Constitutional/general health:** denies  
**Ear/nose/throat:** denies  
**Cardiovascular:** hypertension  
**Pulmonary:** denies  
**Endocrine:** denies  
**Dermatological:** denies  
**Gastrointestinal:** denies  
**Genitourinary:** denies  
**Musculoskeletal:** denies  
**Neurologic:** denies  
**Psychiatric:** denies  
**Immunologic:** denies  
**Hematologic:** denies  
**Mental status**  
**Orientation:** oriented to time/place/person  
**Mood:** appropriate  
**Affect:** appropriate



**Clinical findings:**  
**VA without correction:**  
**Distance** **Near**  
 OD: 20/25 20/40  
 OS: 20/50 PH 20/40 20/50  
**Habitual distance Rx:** none  
**Pupils:** PERRL, negative APD  
**EOMs:** full, no restrictions OD, OS  
**Confrontation fields:** full to finger counting, OD, mild constriction 360° OS  
**Cover test:** 3XP, 6XP  
**Stereo:** + forms, 50" of arc  
**Retinoscopy:**  
 OD: +1.50-0.25 x 180 20/20  
 OS: +1.50-0.50 x 180 20/40  
**Subjective refraction:**  
 OD: +1.50-0.25 x 170 20/20  
 OS: +1.00-0.50 x 180 20/30<sup>-1</sup>  
 add +1.00 20/20 OD, 20/30<sup>-1</sup> OS  
**Von Graefe phoria:** 10 XP  
**Slit lamp:**  
**Lids/lashes/adnexa:** mild posterior blepharitis OD, OS  
**Conjunctiva:** mild injection OD, OS  
**Cornea:** clear OD, OS  
**Anterior chamber:** deep and quiet OD, OS  
**Iris:** brown and flat OD, OS  
 anterior chamber angle: grade 4 nasal and temporal OD, OS  
**Lens:** clear OD, OS  
**Vitreous:** clear OD, OS  
**IOPs:** 14 mmHg OD, 33 mmHg OS at 1:20 pm with Goldmann applanation tonometry  
**Blood pressure:** 130/80 mmHg right arm sitting at 1:25pm  
**Fundus OD:**  
 See IMAGE below at left; periphery: unremarkable  
**Fundus OS:**  
 See IMAGE below at right; periphery: unremarkable  
**Additional testing:**  
 Humphrey visual field: See OD IMAGE (below at left) and OS IMAGE (below at right)





when notified by the proctors. They are reminded of the amount of time they will be given to complete the case (16 minutes during the first quarter with the time being reduced by 2 minutes each subsequent quarter). An end time is displayed on the classroom screen so that students can self-monitor their pace. The proctors alert students when 7 minutes have passed and again when 1 minute remains. Students are allowed to bring any non-electronic (to ensure no communication between classmates) reference material to class for use during completion of the case. At the end of the allotted time period, the completed Scantron forms are collected, but the students retain the printed case information for reference during the discussion period, which immediately follows.

### Case discussion

The case author reviews the case and questions with the remaining class time (approximately 30 minutes). The presenting faculty prepares a PowerPoint presentation that includes statistical data collected from the questions on the LMS so that the students can view the overall class performance. These data help the presenter guide the discussion, placing emphasis on areas of confusion. Similar data for the in-class questions are generated in real-time using an audience response system. The faculty clarifies the difference between each option and explains why each is correct and/or incorrect, placing an emphasis on the options that were popular distractors.

The PCC coordinator remains in the classroom during both the in-class case and subsequent discussion. The coordinator is available to assist with anything the presenter may need, including help with Scantron collection and technical assistance in the Smart Classrooms.

### Grading

The scores from the questions presented in class (not the LMS version of the case) comprise 4% of the student's final clinic grade. Because four cases are presented each quarter with 6-7 questions per case, the final score is derived from approximately 24-28 questions. The class mean and standard deviation (SD) are calculated. If the student's final score falls within 1 SD of the mean

**Table 1**  
**Case Types Presented During Primary Care Conference**

• Refractive Condition	• Anterior Segment	• Glaucoma
• Binocular Vision	• Low Vision	• Pediatrics
• Posterior Segment	• Ophthalmic Optics	• Post-Surgical

**Figure 2**  
**Learning Management System (LMS) Questions**

The questions that are posted with the case information on the LMS. The questions include commentary to supplement the article text. All multiple response questions are scored as "all or none." No partial credit is given.	
Key: 1. C, D, F, I 2. B 3. A 4. A 5. A 6. A, C 7. B	
<b>1. Which of the following best describes the optic nerves? (SELECT ALL THAT APPLY)</b>	
A. 0.3V/0.3H OD, 0.5V/0.5H OS B. 0.5V/0.5H OD, 0.7V/0.7H OS C. 0.65V/0.65H OD, 0.9V/0.9H OS D. Rim tissue perfused OD, OS E. Rim tissue non-perfused OD, OS F. Margins distinct OD, OS G. Margins distinct OD, indistinct OS H. PPA OD, OS I. PPA OS	This question requires interpretation of a visual, which will assist in recognizing the "abnormalities" seen in this patient's optic nerves.
<b>2. Considering the information presented, which of the following is the most likely diagnosis?</b>	
A. Pigment dispersion glaucoma B. Angle recession glaucoma C. Primary open angle glaucoma D. Acute angle closure glaucoma	This question requires clinical thinking, putting the case data and image interpretation together to arrive at a diagnosis. This question is PAIRED with In-Class question #1.
<b>3. When selecting a glaucoma medication for this patient, which of the following mechanisms of action would be most appropriate?</b>	
A. Decreased aqueous humor production B. Increased uveoscleral outflow C. Increased trabecular meshwork outflow D. Formation of an osmotic blood-vitreous gradient	This question builds on LMS question #2 by placing emphasis on the fact that the etiology of the condition must be considered prior to selecting a treatment. It also underscores the importance of pathophysiology and serves to foreshadow In-Class questions. This question is PAIRED with In-Class question #2.
<b>4. Which of the following fields on the visual field printout confirms that this patient has absolute defects?</b>	
A. Raw Data B. Total Deviation C. Pattern Deviation D. Total Deviation Probability Plot E. Pattern Deviation Probability Plot	This question serves to remind students of content taught in the didactic curriculum. No analysis of data is required to answer this question. This question is PAIRED with In-Class question #3.
<b>5. Assuming the phoropter is set at plano, your working distance is 66 cm, your initial reflex when you begin retinoscopy using the plane mirror position on this patient would have been?</b>	
A. With movement B. Against movement C. Neutral	This question aids with content review from the didactic curriculum and requires a small amount of data analysis. This question is PAIRED with In-Class question #4.
<b>6. Which of the following tests should be performed prior to prescribing the subjective refraction and add to ensure the patient will not experience diplopia? (SELECT ALL THAT APPLY)</b>	
A. NPC B. Worth 4 dot C. BO vergence at near D. BI vergence at near E. Fused crossed cylinder	This question serves to remind students that patients in clinic often present with multiple problems that involve both knowledge of binocular vision and disease.
<b>7. Which of the following lens changes would be the just noticeable difference (JND) for the patient's left eye?</b>	
A. 0.25 DS B. 0.50 DS C. 0.75 DS D. 1.00 DS	This question functions to review when to deviate from our "standard routine." A very small amount of data analysis is required to answer this question. This question is loosely PAIRED with In-Class question #6.

(above or below) the student receives 3%. If the student achieves a final score above 1 SD of the mean, the student receives 4%. If the student's final score is below 1 SD of the mean, the student receives 0%.

## Discussion

Primary Care Conference cases have become a core component of the third-year clinical education at ICO. This learner-centered module boasts objectives that extend far beyond simple content mastery. The overarching student objectives to these cases include but are not limited to: lifelong learning, knowledge-base enhancement, clinical thinking refinement (data analysis and interpretation of visuals), understanding treatment/management hierarchy, problem-solving efficiency and preparation for NBEO Part II. From a curricular stand point, the deliberate rotation of case types standardizes clinical exposure during the third year, which provides each student an introduction to fundamental conditions and concepts prior to his/her fourth-year clinical rotations. PCC also ensures that the entire class experiences a given case rather than relying on happenstance to provide each student with an individual clinical patient encounter of each type. In addition to student objectives, these cases provide faculty and administration with opportunities to develop junior faculty, contribute to curriculum vitae building, and reinforce basic health science integration into clinical practice.

Studies have shown that data analysis and interpretation is a challenge for medical students.<sup>1,8</sup> We have found that our optometry students are similarly challenged. Thus, the concept behind the PCC cases is to "break down" the thinking into a stepwise activity and guide the student through the process. Placing the lower-level questions on the LMS offers the student the opportunity to review the case and content in a lower stress environment, which will prepare him/her for the graded in-class case. Since the topics selected for the cases have already been covered in the didactic curriculum, each student will view the case with a different knowledge base, depending on how much he/she recalls from his/her courses. This

<b>Figure 3 In-Class Questions</b>	
The questions that are printed with the case information for the In-Class case. The questions include commentary to supplement the article text. All multiple response questions are scored as "all or none." No partial credit is given.	
Key: 1. C 2. E 3. A,D 4. B 5. B 6. B	
<b>1. A gonioscopic view of this patient's anterior chamber angle most likely would reveal a:</b>	
A. separation of the ciliary body from the scleral spur B. convex iris with apposition of the peripheral iris against the trabecular meshwork C. tear between the longitudinal and circular muscles of the ciliary body D. dense homogenous band of dark brown pigment in the trabecular meshwork	This question is a basic science correlate to learning management system (LMS) question #2. Reviewing the case on the LMS would assist the student in answering this question.
<b>2. Which of the following medications would be the most appropriate initial treatment?</b>	
A. Diamox B. Travatan Z C. Pilocarpine D. Cosopt E. Timoptic XE	This question is the clinical correlate to LMS question #3. This question reviews contraindications and mechanisms of action of various glaucoma medications. This question requires a fair amount of data analysis; however, the LMS questions serve as a stepping stone to reach this level of critical thinking.
<b>3. Which of the following statements best describes this patient's left visual field? (SELECT ALL THAT APPLY)</b>	
A. Inferior nasal has 2 absolute defects B. Inferior nasal has 9 absolute defects C. Inferior nasal has 14 absolute defects D. Superior nasal has 13 absolute defects E. Superior nasal has 14 absolute defects	This question is PAIRED with LMS question #4. It requires application of the content tested in LMS question #4.
<b>4. Assuming the phoropter is set at +1.50, your working distance is 66 cm, your initial reflex when you begin retinoscopy using the concave mirror position on this patient would have been?</b>	
A. With movement B. Against movement C. Neutral	This question is PAIRED with LMS question #5.
<b>5. Considering the refractive results, which of the following NRA/PRA results are most likely?</b>	
A. +0.75/-0.75 B. +1.50/-1.50 C. +2.25/-2.25 D. +3.00/-3.00	As with LMS question #6, this question serves to remind students that patients in clinic often present with multiple problems that involve both knowledge of binocular vision and disease.
<b>6. Which of the following is the most appropriate approach to balance accommodation?</b>	
A. 3BU/3BD B. Red/Green C. Alternate occlusion D. Balancing accommodation is irrelevant on this patient	This question is loosely PAIRED with LMS question #5. This question also demonstrates that questions can be PAIRED to different degrees.

process aids the student in identifying information that he/she does not know. Therefore, the LMS case serves as a good content review with an opportunity to apply the information to a given patient scenario.

When the student first opens the case on the LMS, he/she has no idea what topic will be presented. This is intentional to mimic a patient walking into the clinic. Students have to read the case and answer the questions in the allotted time, primarily with the knowledge they retained from their didactic courses. They are allowed to use references, but the time limitation often

does not allow for much referencing initially. Once they complete the case, they are able to go back to review the case to see how they performed. The review screen displays both the student answers and the correct answers. The students can review the case for as long as they want and as many times as they want until the case closes shortly before the in-class version is presented. The students know that the in-class case will be the same, so it motivates them to review and understand the case to achieve a better grade in class. Furthermore, reviewing the LMS questions independently sets the stage for a

deeper more meaningful discussion in the classroom. The review process fosters lifelong learning. The open-book nature of the case interaction encourages the student to independently retrieve evidenced-based information to solve problems. Additionally, this gives the student an opportunity to evaluate which references are most appropriate under different conditions. Reference familiarity results in efficient information retrieval, which is an important lifelong learning skill.

The design of the questions is very purposeful. There are 2-3 questions aimed at content review with minimal interpretation needed to arrive at the correct answer. This is a good opportunity to include interpretation of visuals (ocular images, visual field printouts, optical coherence tomography printouts, etc.). In our example, LMS question 1 involves visual interpretation, and LMS questions 4 and 7 involve simple content review with little to no data analysis required to answer the questions. The remainder of the questions are aimed at improving clinical and critical thinking. These questions often require a 2- or 3-step process to arrive at the correct answer. Some of the questions are designed to set the stage for the subsequent question, reducing the number of steps required to arrive at the answer. For example, LMS question 2 assists the student with arriving at the diagnosis. The answer to question 2 serves as a stepping stone to answer question 3, which asks underlying pathophysiology. One could simply ask question 3 without question 2; however, this would raise the level of difficulty of question 3. In this instance, question 3 requires data analysis, diagnosis and then an application of basic science concepts. This stepwise process is all too familiar to experienced clinicians and becomes second nature; however, to novice clinicians and students, this process is foreign and must be learned. We often split the multi-stepped process between questions on the LMS and in-class questions. For example, LMS question 2 facilitates the analysis required to answer in-class question 1. Another example of interconnected questions is LMS question 3 and in-class question 2. Having to independently tackle clinical prob-

lems, develop an answer rationale, and participate in a class discussion of the item distractors led by an experienced clinician helps the student enhance his/her ability to think through a case in a logical stepwise manner. Additionally, because PCC is moderated by many faculty members throughout the academic year, the student gains some appreciation that there is often more than one way to manage a clinical problem. This variety in clinical approaches allows the student to further understand treatment/management hierarchy, why certain treatments are good, why others are better and which is best given the situation.

In addition to enhancing the student's content knowledge base, the cases give students a preview of common clinical mistakes. Because faculty choose real case scenarios with which they frequently witness students struggling in clinic, the student in PCC gains exposure to these frequent mistakes. Calling attention to such errors helps the student avoid making the same mistake when encountering a similar case in clinic. Furthermore, the cases reinforce basic health science integration into clinical practice. Students and optometrists often fail to recognize the relevance of their basic health science coursework. Primary Care Conference directly connects relevant basic health science concepts to the clinical cases at hand. Finally, because the students review the content of the case using references, their knowledge base is strengthened through application rather than simple memorization. This is accomplished by both the independent study and in-class discussion.

The lively discussions that often ensue during PCC encourage students to professionally communicate in a group setting. Being able to respectfully disagree in a collegial environment is a helpful skill for future optometric practice. Because the discussion immediately follows the in-class case, it is important that the questions are error-free.

Lastly, the cases prepare the students for the NBEO Part II: Patient Assessment and Management Examination. The patient information is presented in the same format that is used for this portion of the board examination. The format and timing allow students to gain

familiarity with the examination structure. The board examination requires students to complete 30 cases in 3.5 hours (210 minutes), thus they must pace themselves at an average of 7 minutes per case. For this reason, we give the students a 7-minute warning during the in-class cases to increase their awareness of time passed and efficiency.

As mentioned earlier, we have found that there are a number of advantages to these cases from a faculty and administration viewpoint. The participating faculty experiences more mentoring and educational interactions. Primary Care Conference provides an opportunity for him/her to discuss clinical cases with other faculty members in a deliberate way. This allows the faculty member to have increased exposure to his/her mentors or mentees.

For newer faculty members, PCC provides lecture experience in a supportive team environment. It may be difficult to gain lecture experience prior to becoming responsible for a significant portion of a course. Even then, faculty members are often left to themselves to develop course materials and a lecture style. Primary Care Conference provides a venue for a faculty member to gain experience in organizing classroom materials, developing PowerPoint presentations, writing quality exam items, reviewing question statistics and lecturing, all with the direct assistance and feedback from skilled faculty members. PCC presenters are not formally evaluated by students because many faculty present in a single academic quarter. However, the presenting faculty and PCC coordinator meet informally to discuss how the cases can be improved for subsequent years.

Having to develop cases, write exam items, and articulate treatment/management rationales encourages the faculty member to delve into the evidenced-based literature to justify the various item answers and distractors. Reviewing this knowledge helps the faculty member to become a more effective teacher, clinician and clinical preceptor.

Particularly in a departmentalized academic setting, most faculty gain experience with only a subset of clinical cases. For example, the faculty member work-



ing only in the Binocular Vision Service will seldom manage adult ocular disease. Primary Care Conference gives an opportunity for the faculty member to interact with new and different cases presented by other faculty members, increasing his/her exposure to a diversity of cases. This provides a good review and even expands his/her clinical repertoire.

Just as with the students, the cases reinforce basic health science integration into clinical practice. Having to develop basic health science case questions allows the faculty member to engage with clinically relevant basic science content. Reviewing basic health science concepts helps the faculty member to be a better clinical preceptor. Most basic science lecturers are effective at making basic health science course work clinically relevant, but it is important to encourage clinical preceptors to reinforce basic health science importance as well.

Participation in PCC provides evidence of teaching and contributes to curriculum vitae building, which allows the faculty member to be more successful in the merit and promotion process.

## Outcomes

Measuring a change in critical thinking and data processing aptitude is difficult. However, despite the fact that PCC is not formally evaluated by students, we have received a number of direct comments from fourth-year students. They believe that the cases assist with clinical thinking development by giving them additional opportunities to analyze a large volume of patient data and realize the correlation between the information. They went as far as to suggest that the number and frequency of these cases should increase in the curriculum. The suggestion was to begin the cases in the first year and have them continue throughout the third year. This would allow for earlier development of the data analysis skill. Additionally, based on feedback from curriculum focus groups, the students feel these cases play a role in their success on standardized examinations.

We have found the discussion portion of PCC to be extremely important to emphasize the stepwise nature of data

assimilation and clinical reasoning. For example, when looking at the total percent correct on LMS question 2 (diagnosis question), which is designed to be a stepping stone for a multi-stepped question, one can compare the performance of two multi-stepped questions, one with and one without the benefit of discussion. There was a 28% increase in a multi-step question relating to LMS question 2 when asked during the discussion. Alternatively, there was a decrease in 29% percent in total percent correct on a multi-step question relating to LMS question 2 when the students were left to answer the question independently. This difference in percent correct may suggest that the discussion is aiding with critical analysis and understanding the process necessary to make clinical decisions.

Statistical analysis of the case questions also plays a key role in the development/improvement of the cases over time. It is important to consider the question statistics to ensure the goal is being achieved. Key statistics to consider are the total percent correct, the percent correct for the upper 27% of students, the percent correct for the lower 27% of students and ultimately the discrimination index (DI, which is the difference between the upper 27% and lower 27% of the class). When looking at the statistics, one must keep in mind that case topics may be selected with the intent of targeting common clinical pitfalls, which may negatively impact total percent correct. Therefore, considering only total percent correct may not fully represent the question reliability. The authors recommend looking at the question DI in conjunction with the total percent correct.<sup>9</sup> It has been found that our case questions rarely have DI values lower than 0.35 on any given case. This most likely is the result of the content application nature of the case questions. For example, the average DI on the sample LMS case questions was 0.51. Because overall percent correct may be lower than desired, we only grade the in-class cases and base the grades on the mean and standard deviation. This grading method allows us to truly capture the outliers in the class. If these students are deficient in both conference and clinic, then they are remediated individually through our Pri-

mary Care Clinical Support Program. The program provides support through additional case reviews with a faculty mentor, supervised technical skills practice and critical written reviews by an attending faculty member who is assigned to individually observe the student's clinical patient encounters. As the academic year progresses, the time allocated to complete the PCC cases decreases and the level of case complexity increases. Despite these time and content changes, the mean percent correct on the cases remains similar thus suggesting an improvement in clinical thinking.

## Conclusions

Primary Care Conference provides the tools and experiences necessary to improve students' ability to think clinically and apply didactic knowledge to clinical patient care through hybrid project-based learning. The wide variety of cases aids students in identifying areas of weakness in their current knowledge base, while the open book nature of PCC allows students to become more familiar with quality reference material and how to access information effectively, which is a critical skill for lifelong learning. The format of the clinical cases familiarizes students with the NBEO Part II exam structure.

PCC also provides many benefits to the faculty members involved. It aids in the development of junior faculty, increases their exposure to students, expands clinical knowledge, reinforces importance of basic science, and aids in curriculum vitae building.

Despite the lack of true outcome measures of a change in student clinical thinking aptitude, ICO has adopted this approach based on feedback and general impressions. Problem-based learning has been well studied and has a strong history of positively impacting students,<sup>6,7,10</sup> thus we are pleased that we have discovered a novel format that allows us to provide our students with the benefits of problem-based learning but in a large class setting.

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