



Medical Student Ophthalmic Knowledge Proficiency after Completing a Clinical Elective or an Online Course

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Abstract

Background As more information is being packed into medical school curricula, mainstream medical topics legitimately receive more attention than specialty topics such as ophthalmology. However, general practitioners, as gatekeepers of specialty care, must attain competency in ophthalmology. We have investigated whether an online ophthalmology course alone would be noninferior to the same online course plus an in-person clinical elective in providing ophthalmic knowledge.

Methods Students at the University of Michigan Medical School voluntarily enrolled in one of two groups: an Online Only group requiring satisfactory completion of an online course entitled “The Eyes Have It” (TEHI) or a Clinical + Online group requiring students to complete a 2-week clinical rotation and the TEHI online course. The outcome metric was the score on an independent 50-question written examination of ophthalmic knowledge. Students also completed a survey assessing confidence in managing ophthalmic problems.

Results Twenty students in the Clinical + Online group and 59 students in the Online Only group completed the study. The Clinical + Online group slightly outscored the Online Only group (86.3 vs. 83.0%, $p = 0.004$). When the two outlier questions were removed from the analysis, there was no difference in mean scores between the two groups (85.8 vs. 85.4, $p = 0.069$). Students in the Clinical + Online group devoted 80 more hours to the experience than did the students in the Online Only group. The number of hours devoted to the course and interest in ophthalmology were weakly correlated with examination performance. After completion of the experiment, there was no difference in student-reported comfort in dealing with ophthalmic problems between the two groups.

Conclusion The examination scores of the students who completed the in-person alone were only slightly inferior to those of the students who completed the in-person clinical elective and the online course. These results suggest that an online course alone may provide a satisfactory ophthalmic knowledge base in a more compact timeframe, an alternative that should have appeal to students who do not intend to pursue a career in ophthalmology.

Keywords

- ▶ online course
- ▶ clinical elective
- ▶ clinical rotation
- ▶ ophthalmology medical education

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Introduction

Medical school curricula are challenged with transmitting an ever-increasing amount of information to students.¹ As a result, emphasis has necessarily shifted toward mainstream topics, such as internal medicine and general surgery, and away from the more nonmainstream, specialized disciplines. Yet, the health care system designates primary care providers (PCPs) as gatekeepers of nonmainstream care, so they must acquire enough knowledge of medical specialties to be able to treat and triage appropriately.²

Among the nonmainstream medical specialties is ophthalmology. Equipping medical students with an adequate knowledge of ophthalmology is important because ophthalmic symptoms are common among patients consulting PCPs.^{3,4} Even so, a survey of program directors in family, internal, and emergency medicine found that medical students and physicians are inadequately trained to deal with the initial management and appropriate referral of the most basic ophthalmic problems.² Meanwhile, ophthalmology education in medical school is being marginalized as a consequence of reduced access to ophthalmic clinical skills training in medical curricula, a trend that is increasing because of constraints in time, funding, teachers, and resources. Liesegang et al⁵ listed the following three reasons for this marginalization: competition among medical specialties desiring time to teach, lack of commitment of ophthalmology teachers in medical schools, and greater availability of community ophthalmologists and optometrists, so that PCPs view substantial knowledge of the eye and its diseases as unnecessary.

To combat this problem, online teaching and “flipped classrooms” teaching have emerged as alternatives. These approaches have become even more relevant to undergraduate medical education in the novel coronavirus disease 2019 (COVID-19) pandemic period, during which students have had to forgo in-person clinical electives in search of other means of learning. In the pre-COVID-19 era, Petrarca et al⁶ found that among 245 British medical students who were taught ophthalmology concepts via online modules or in-person lectures, those who had completed the online modules performed better on a 100-question written examination than those who had attended traditional lectures. Students who took the online modules were also more satisfied with the course.⁶ Tang et al,⁷ Lin et al,⁸ and Diel et al⁹ also found that, compared with a traditional curriculum of didactic lectures, flipped classrooms in ophthalmology do not decrease test scores but do increase student satisfaction.

Although many studies have shown the benefit of using online and flipped ophthalmology courses in place of curricula with didactic lectures, no study has compared an in-person clinical experience to the use of these approaches. Accordingly, we designed a study to assess the performance on a multiple-choice ophthalmic knowledge proficiency examination of medical students at the University of Michigan Medical School who had completed a 2-week in-person elective in the ophthalmology clinics and operating rooms, together with an online course, as compared with the performance of medical students who had completed an online course alone. We also

surveyed both groups of students before and after the course to assess pertinent group characteristics and perceptions.

Methods

Subject Selection

All subjects were third or fourth year medical students in the 2019 to 2020 academic year matriculating at the University of Michigan. They had already completed the seven core clinical electives (internal medicine, family medicine, psychiatry, neurology, surgery, obstetrics and gynecology, and pediatrics) and the U.S. Medical Licensing Examination (USMLE) Step 1 examination. We did not know whether the students had already completed the USMLE Step 2 Clinical Knowledge or Clinical Skills examinations.

Courses

Subjects were voluntarily enrolled through the online medical student course catalog for one of two elective courses. The choices were an online course alone (Online Only) or a combined 2-week clinical elective and online course (Clinical + Online). The Online Only group was targeted at medical students who were contemplating a career in fields other than ophthalmology. They were required to obtain satisfactory scores on the quiz portion of an online course entitled “The Eyes Have It” (TEHI), consisting of nine didactic modules and quizzes. There were no lectures or clinical duties. The combined clinical and online elective (Clinical + Online) group was designed for students considering ophthalmology as a career. They enrolled in the standard 2-week clinical elective offered by the University of Michigan, Department of Ophthalmology and Visual Sciences, which included attending 3 hours of in-person lecture and spending 80 hours in the clinics or operating rooms, as well as obtaining satisfactory scores on the quiz portion of TEHI. Both groups were permitted to use outside teaching materials and were required to complete an ophthalmic knowledge proficiency written examination.

The online course, TEHI,¹⁰ is a free web site in the public domain coauthored by two of the investigators (J.D. T. and J.J.A.H.). It consists of nine didactic modules covering eye symptoms and signs, red eye, eye trauma, ophthalmic and systemic conditions, side effects of medications, the ophthalmic screening examination, ophthalmoscopic abnormalities, and anatomic pathways of the eye and visual system. All enrollees were required to complete the nine multiple-choice quizzes, one for each of the nine TEHI modules, with a total of 140 questions. Each question included a written explanation for the correct and incorrect answer choices, a format similar to that found in commercial question banks that medical students use to prepare for the USMLE. Students in the Clinical + Online and the Online Only groups were required to score at least 80% on each quiz to receive credit for the course. They were permitted to take each quiz as many times as needed to obtain the 80% passing score. The TEHI authors had no input into the ophthalmic knowledge proficiency written examination.

Ophthalmic Knowledge Proficiency Written Examination

Serving as the criterion of ophthalmic knowledge proficiency, this 50-question multiple-choice examination was compiled from ophthalmology teaching textbooks and written examinations used at other academic institutions (Appendix). It was assembled by one of the investigators (A.D.K.), who had no input into the TEHI modules or quizzes and had not studied their content. The examination was reviewed for its pertinence to nonophthalmic medical practice by an emergency medicine resident physician, two pediatric resident physicians, and an internal medicine resident physician. Clinical + Online and Online Only students completed the examination on the Canvas teaching online platform (Instructure, Salt Lake City, UT). All students were required to attest to the University of Michigan honor code prior to taking the examination.

Precourse and Postcourse Surveys

Students in both groups completed two surveys. The precourse survey was designed to provide information about whether students were in the career exploration phase of electives during the time they participated in the courses, their reasons for enrolling in the courses, and whether they had had any previous experience in shadowing an ophthalmologist or doing ophthalmic research. It also collected baseline levels of their intentions to pursue a career in ophthalmology and their confidence in managing ophthalmic problems. The postcourse survey was designed to elicit the amount of time the students spent on the course, outside

resources they used during the course, a change in their intention to pursue a career in ophthalmology, and a change in their confidence in managing ophthalmic problems. Survey responses assessing baseline and change in intention to pursue a career in ophthalmology and confidence in managing ophthalmic problems were graded on a 5-point Likert's scale with 1 = definitely not/strongly disagree and 5 = definitely/strongly agree (→ Tables 1, 2).

Four students, three from the Online Only group and one from the Clinical + Online group, did not answer the survey questions and were excluded from the study.

Statistical Analysis

We performed bivariate analyses using IBM SPSS Version 26 (Armonk, NY). Chi-square tests were used to compare categorical survey responses between the two groups. Fisher's exact tests were used when there were small sample sizes among comparison groups. Unpaired, two-sample *t*-tests were performed using the DataAnalysis ToolPak by Microsoft Excel (Seattle, WA) for comparing continuous outcomes from the survey results and examination scores between the two groups. The Holm–Bonferroni method¹¹ was used to adjust for multiple comparisons when comparing performance between groups on single ophthalmic knowledge proficiency examination items. Lastly, correlation coefficients were computed using the DataAnalysis ToolPak by Microsoft Excel (Seattle, WA).

Ethics

The University of Michigan IRB reviewed the study and determined it to be exempt (HUM00161915). Data were

Table 1 Survey eliciting pertinent characteristics of the two student groups

		Clinical + Online <i>n</i> (%)	Online Only <i>n</i> (%)	<i>p</i> -Value
		<i>n</i> = 20	<i>n</i> = 59	
	Mean age (range)	26.0 (23–30)	26.9 (24–27)	0.10
	Gender (% women)	8 (40)	33 (56)	0.33
Precourse	1. Career exploration phase of medical school	16 (80)	10 (17)	<10 ^{−4}
	2. Why are you taking this course?			
	Explore a career in ophthalmology	15 (75)	0 (0)	<10 ^{−4}
	Strengthen clinical understanding of ophthalmology	18 (90)	55 (93)	0.64
	Have exposure to ophthalmology faculty	11 (55)	0 (0)	<10 ^{−4}
	Flexibility for travel or studying for USMLE step 2	2 (10)	31 (53)	<10 ^{−4}
	3. Previous exposure to ophthalmology	11 (55)	7 (12)	<10 ^{−4}
Postcourse	4. Use of outside teaching resources	10 (50) ^a	5 (10) ^b	0.002
	5. Time devoted to completing TEHI modules and quizzes (h)			
	Total	20.5	19.5	0.59
	Time devoted to completing TEHI modules	12.5	12.5	0.99
	Time to complete TEHI quizzes	8.8	7.0	0.33

Abbreviations: TEHI, the eyes have it; USMLE, U.S. Medical Licensing Examination.

^aClinical + Online students used the American Academy of Ophthalmology (AAO) Web site,¹² Basic Ophthalmology: Essentials for Medical Students,¹³ and OphthoBook.¹⁴

^bOnline Only students used notes from the pre-clinical ophthalmology block, American Academy of Family Physician (AAFP) guidelines,¹⁵ and UpToDate.¹⁶

Table 2 Survey eliciting changes in pertinent student perceptions after completing the course

		Clinical + Online n = 20	Online Only n = 59	Difference	p-Value between groups
1. I will be pursuing a career in ophthalmology	Precourse	3.00	1.12	1.88	<10 ⁻⁴
	Postcourse	3.50	1.14	2.36	<10 ⁻⁴
	Change	0.50	0.02	0.48	<10 ⁻⁴
2. I have an appropriate understanding of ophthalmic diseases expected of non-ophthalmologists	Precourse	2.55	2.14	0.41	0.064
	Postcourse	4.15	3.85	0.30	0.15
	Change	1.60	1.71	-0.11	0.67
3. I know which ophthalmic problems can be handled by a general practitioner	Precourse	2.35	2.34	0.01	0.97
	Postcourse	4.10	3.97	0.13	0.45
	Change	1.75	1.63	0.12	0.65
4. I know when an ophthalmology consult is appropriate	Precourse	2.50	2.63	-0.13	0.59
	Postcourse	4.20	4.20	0.00	0.98
	Change	1.70	1.57	0.13	0.62
5. I know how urgently each ophthalmic presentation needs to be referred to an ophthalmologist, if at all	Precourse	2.30	2.24	0.06	0.81
	Postcourse	4.10	4.15	-0.05	0.76
	Change	1.80	1.91	-0.11	0.68
6. I know how an ophthalmologist can contribute to the overall care of patients with nonophthalmic diseases (diabetes mellitus, rheumatoid arthritis)	Precourse	3.50	3.27	0.23	0.41
	Postcourse	4.85	4.47	0.38	0.02
	Change	1.35	1.20	0.15	0.61

Note: Results are averages of responses scored on a Likert scale (1 = definitely not/strongly disagree, 5 = definitely/strongly agree). The vertical column titled "Difference" represents Clinical + Online minus Online Only survey responses for each question. The "Change" rows represent postcourse minus precourse survey responses.

collected anonymously and students had the option to not complete the surveys.

Results

During the study period, 20 students completed the Clinical + Online course and 59 students completed the Online Only course.

Proficiency

On the 50-question ophthalmic knowledge proficiency written examination, the Clinical + Online group performed slightly better than the Online Only group (mean [standard deviation (SD)] score, 86.3 (5.6) vs. 83.0% (3.7), $p = 0.004$), approximately equivalent to a 2-question difference in performance between the two groups. The following two questions stood out as those that most separated the performance of the Clinical + Online and Online Only students:

1. A 45-year old man sustains an alkali injury to his left eye while working. He rushes to the emergency room and you proceed to irrigate his left eye until? Correct answer: the pH neutralizes (Clinical + Online with 95% students answering correctly, Online Only with 59%, $p = 0.003$).

2. A 40-year old man reports that he has intermittent blurry vision that improves with blinking. On further questioning, he says that it only occurs at the end of a work day after using the computer for many hours. The most likely diagnosis is? Correct answer: dry eye syndrome (Clinical + Online with 100% answering correctly, Online Only with 76%, $p = 0.016$).

The answers to these two questions were not addressed in TEHI. If the average test scores between the two groups are compared after excluding these two questions, there is no difference in the examination scores of the two groups (85.8% for Clinical + Online vs. 85.4% for Online Only, $p = 0.069$).

Surveys

There were differences in the characteristics of the Clinical + Online and Online Only groups (► **Tables 1, 2**). First, Clinical + Online students were much more likely to be in the career exploration phase (80%) of their medical education than were the Online Only students (17%). A nearly equal percentage of the Clinical + Online students (90%) and Online Only students (93%) took the course to strengthen their understanding of ophthalmology. Fifteen (75%) Clinical + Online students took the course to explore a career in

ophthalmology, whereas no Online Only students did so for that purpose. Eleven (55%) Clinical + Online students took the in-person course to gain exposure to ophthalmology faculty, whereas no student in the Online Only group sought that exposure. Thirty-one (53%) Online Only students took the course for flexibility to travel or study for the USMLE step-2 as compared with 10% of students in the Clinical + Online group. A higher proportion of Clinical + Online than Online Only students had had previous clinical or research exposure to ophthalmology.

Both groups spent an average of approximately 20 hours completing TEHI modules (20.5 for the Clinical + Online group and 19.5 for the Online Only group). However, the Clinical + Online group had an additional 83 hours of requirements, including 48 hours in clinic, 32 hours in the operating room, and 3 hours in lecture. A larger proportion of students in the Clinical + Online group (50%) used additional resources than in the Online Only group (10%, $p = 0.002$). Clinical + Online students used more traditional teaching resources than did the Online Only students (► **Table 1**).

In the answer to the postcourse survey question designed to elicit whether students had shifted in their intention to pursue a career in ophthalmology, there was significant increase in the Clinical + Online cohort and little change in the Online Only cohort. In the answers to questions aimed at student-perceived preparedness in dealing with ophthalmic problems, there were no significant differences in the changes from precourse to postcourse responses between the two groups. (► **Table 2**).

When all 79 students were analyzed as a single group, a linear regression showed that the self-reported number of hours devoted to the course was weakly correlated to the final examination score ($r = 0.28$, $p = 0.013$). Similarly, interest in pursuing a career in ophthalmology was weakly correlated to final examination score ($r = 0.22$, $p = 0.046$).

Discussion

Students in the Clinical + Online group performed slightly better on the written ophthalmic knowledge proficiency written examination than did the students in the Online Only group, approximately equivalent to 2 out of 50 questions. This difference may have been influenced by the content of these two questions, which were not covered adequately, if at all, in the TEHI modules. Once these questions were removed from the analysis, the difference in average examination scores between the two groups was not significant, suggesting non-inferiority in the performance of the Online relative to the Clinical + Online group. The ability of the Clinical + Online students to answer those two questions correctly may be attributable to their being more interested in pursuing a career in ophthalmology and in reading more outside resources.

This small difference in knowledge proficiency must be balanced against the substantial increase in time devoted to the clinical rotation. It must also be balanced against the fact that student responses showed no difference between the two groups in regard to their self-perceived comfort in managing common ophthalmic problems. The two groups

expressed an equal baseline comfort level and reported an equal increase in comfort managing common ophthalmic problems after the course.

A critical problem in the training of medical students on ophthalmology clinical electives is the lack of exposure to a broad range of ophthalmic conditions. Students must settle for encountering only those conditions that appear during their rotation time. Even when those conditions are encountered, students are unlikely to view physical examination manifestations in detail, as they are accessible only through biomicroscopy or indirect ophthalmoscopy, examination techniques that students cannot master in a short time. In this respect, there is a clear advantage to online teaching tools, which can cover a wider gamut of the important ophthalmic problems and display them to full advantage. Students can absorb the information at a personalized pace that is optimal for their learning and receive continuous feedback via short quizzes. They can complement their time during the course with other endeavors, which is helpful considering the increasing volume of information that medical students are required to learn. The exigencies of the COVID-19 pandemic brought these advantages to the fore. During that period, 25 additional students signed up for the Online Only option.

We acknowledge that an online course cannot adequately assess a student's ability to execute commonly used ophthalmic clinical examination techniques, including the testing of visual acuity, confrontation visual fields, pupil reactions, ocular motility and ocular alignment, eversion of the eyelid, direct ophthalmoscopy, and the slit lamp examination. These specialized techniques demand considerable monitored practice. To that point, we have observed that medical students participating in clinical electives often do not have much chance to practice these techniques and are rarely evaluated for their proficiency. This issue, which is particularly problematic in instrument-dominated fields such as ophthalmology and otolaryngology, is difficult to rectify, especially as students who are increasingly shuffled between busy clinics.

Limitations

A limitation of this study is the small sample size, which precluded more in-depth statistical analysis and comparison between the two groups. The Online Only group was much larger than the Clinical + Online group. In addition, the validity of the results hinges on whether the ophthalmic knowledge proficiency examination is a reasonable stand-in for the ability to handle ophthalmic problems. Even so, this study's outcomes support the proposition that an online course provides an acceptable means of learning as gauged by knowledge proficiency. The clinical elective might be more appropriate for the small proportion of students (typically 5–8% at this medical school) who have already decided on ophthalmology as a career, or are interested in exploring that possibility, as it allows them to form personal relationships with ophthalmology trainees and faculty ophthalmologists. For the remaining 92 to 95% of medical students who will not choose ophthalmology as a career, an online course should be more than adequate and conserve valuable time. The online-only substitute would also

be applicable to other clinical subspecialties, such as otolaryngology and dermatology, which have similar learning impediments and are suited to a well-designed online course.

Conclusion

If the results of our study can be replicated in a larger cohort, they would suggest that an online course might be a fitting alternative to a clinical elective in the transmission of basic knowledge, especially in a subspecialty of medicine. The clinical exposure could then be devoted more to the transmission of examination skills, a goal that cannot be achieved as well in an online curriculum.

Conflict of Interest

None declared.

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Appendix

Ophthalmic Knowledge Proficiency Written Examination

1. A 50-year-old man with uncontrolled diabetes presents with sudden, painless blurry vision in his left eye. On examination, his vision is 20/400 in the left eye. What is the most likely cause of this vision loss?

- Acute glaucoma
- **Cystoid macular edema**
- Central retinal artery occlusion
- Cataract

2. A 72-year-old man presents with complaints of sudden onset double vision. After examination, you diagnose the patient with a right cranial nerve IV palsy likely from ischemic event. Which statement about binocular diplopia is correct? Binocular diplopia?

- Resolves with artificial tear use
- Resolves on pinhole occluder testing
- Does not resolve when closing the left eye
- **Resolves when the patient closes either the left or the right eye**

3. An 80-year-old man complains of jaw claudication, temporal headache, scalp tenderness, and malaise. What test(s) should be ordered immediately?

- Human immunodeficiency virus
- **C-reactive protein and sedimentation rate**
- Rapid plasma regain
- CBC with differential

4. The best testing method to detect a pupil abnormality is the:

- Confrontation visual field test
- Van Herick's method
- Alternate cover test
- **Swinging light test**

5. As an Emergency Medicine resident, after a brief history and external examination as seen below, what is the appropriate next step while awaiting the ophthalmology consult?



- Palpate the orbital rim assessing for step-off fractures
- **Carefully cover the eye with a protective metal shield**
- Irrigate ocular surface to remove foreign body particulate
- Perform a B-scan ultrasound to rule out retinal detachment

6. Most often symptoms associated with primary open-angle glaucoma includes:

- Floaters
- Ocular redness
- **None**
- Tearing

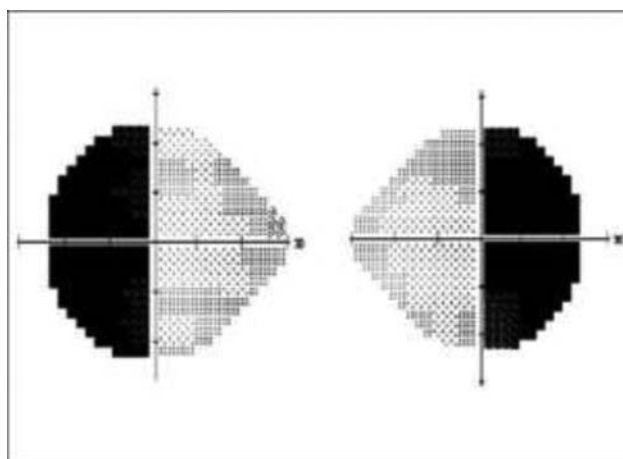
7. A 64-year-old woman presents with flashing lights in peripheral vision of her right eye. The lights have been present for several days. In addition, she notes new, small dark floaters in the right eye. What is the most likely diagnosis for this patient?

- Uncorrected refractive error
- **Retinal tear**
- Branch retinal artery occlusion
- Ocular migraine

8. Patients with diabetes mellitus can experience blurry vision when blood glucose levels are elevated. Which of the following statements correctly explains why hyperglycemia causes blurry vision:

- Hyperglycemia causes the cornea to shrink
- **Hyperglycemia causes the lens to swell**
- Hyperglycemia causes the cornea to swell
- Hyperglycemia causes the lens to shrink

9. A 45-year-old woman presents with 3-month history of peripheral vision loss. Ocular exam is unremarkable. Visual field testing shows the following:



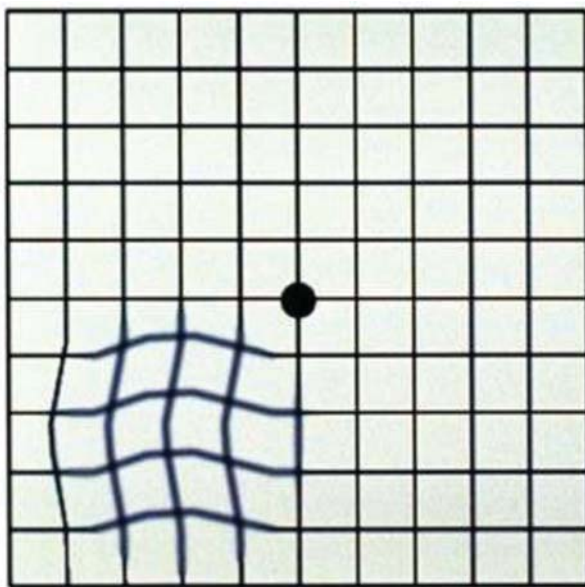
The MRI would likely show the following:

- Retrobulbar meningioma
- An aneurysm of the posterior communicating artery
- Periventricular demyelinating lesion
- **Pituitary adenoma**

10. A 45-year-old man sustains an alkali injury to his left eye while working. He rushes to the emergency room and you proceed to irrigate his left eye until:

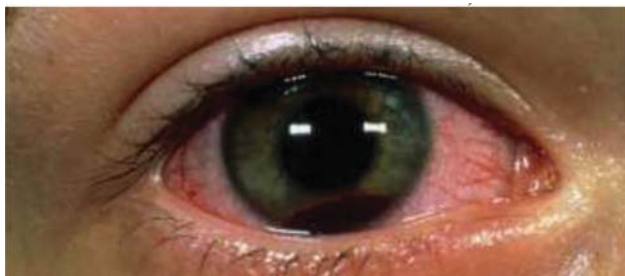
- The cornea turns opaque
- The conjunctival vessels blanch
- **The pH neutralizes**
- No particulate matter is seen in the superior and inferior fornices

11. A 75-year-old woman who has not seen an ophthalmologist in over 10 years presents with new visual distortion in her left eye. The Amsler grid below denotes the metamorphopsia she describes. What is the most likely explanation for her visual distortion?



- Vitreous detachment
- **Exudative macular degeneration**
- Retinal detachment
- Vitreous hemorrhage

12. A 13-year-old boy was hit in the right eye with a soccer ball and presents that day with right eye pain and decreased vision. On examination, his visual acuity is 20/400 in the right eye and intraocular pressure is 40 mm/Hg. The eye appears as in photograph below:



Which of the following is the most likely diagnosis?

- Pigmentary glaucoma
- Acute angle closure glaucoma
- Hypopyon
- **Hyphema**

13. Which of the following statements about corneal ulcers is correct?

- **It can be caused by a viral, bacterial, or fungal infection**
- It is a self-limiting disorder requiring observation only
- If it is a bacterial infection, it is treated with oral antibiotics
- Soft contact lens act as protective barrier and lower risk of corneal ulcer infections

14. A 28-year-old-man presents to the emergency department after being assaulted. He complains of loss of vision in his right eye and severe pain. Examination of his right eye reveals marked proptosis, severe chemosis, and decreased motility of eye in all directions. There is an afferent pupillary defect and the intraocular pressure is noted be markedly elevated. What is the next appropriate step in management?

- **Urgently perform canthotomy/cantholysis in the emergency room**
- Immediately start treatment with topical and IV medications to lower intraocular pressure Urgently take patient to operating room for exploration of possible ruptured globe and orbital wall fracture repair
- Order urgent CT of orbit and head

15. A 36-year-old woman with a recent history of 25-pound weight gain presents with a one-month history of headaches, blurred vision, and nausea/vomiting. What would be the next step in the work up if examination of her optic nerves reveals the following:



- Hemoglobin A1c
- **Computed tomography (CT) of head**
- Lumbar puncture
- Observation

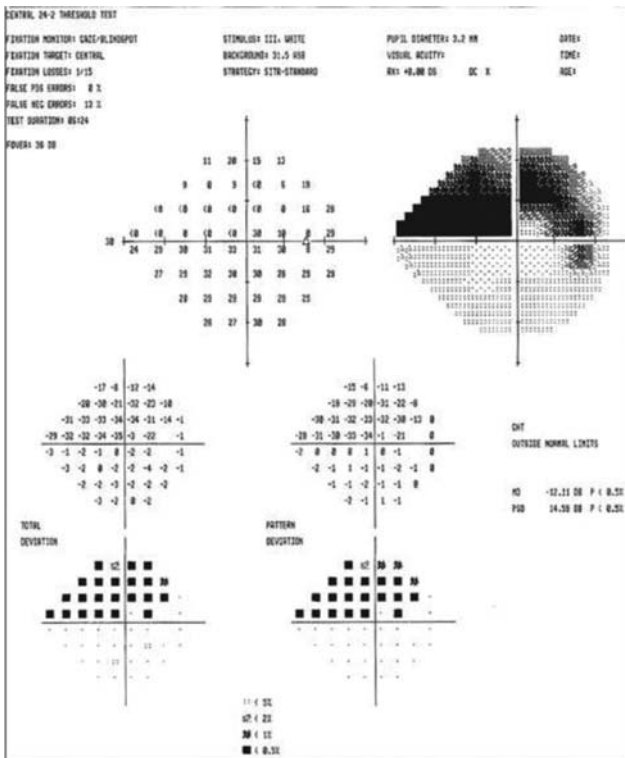
16. Myasthenia gravis can present with the following ocular signs/symptoms:

- Proptosis
- Anisocoria
- Afferent pupillary defect
- **Ptosis of upper eyelid**

17. Dry eyes are commonly associated with which of the following systemic disease processes:

- Diverticulitis
- **Rheumatoid arthritis**
- End stage kidney disease
- Congestive heart failure

18. A visual field defect seen on the Humphrey visual field test below most likely corresponds with:



- A lesion in the parietal lobe
- A lesion in the occipital lobe
- A lesion at the optic chiasm
- **An optic nerve fiber bundle pathology**

19. A common clinical exam finding for nonexudative age-related macular degeneration include:

- Hollenhorst's plaque
- **Drusen**
- Subretinal neovascular membrane
- Retinal ischemia

20. A 35-year-old woman is noted to have right upper lid ptosis and right eye miosis as noted below. Which of the following conditions presents with ptosis and miosis:

- Thyroid eye disease
- Myasthenia gravis
- **Horner's syndrome**
- Giant cell arteritis



21. Which of the following statements is true regarding amblyopia:

- If amblyopia treatment is initiated at any age, vision can improve
- Amblyopia can develop in infancy, childhood, or adulthood
- Amblyopia is a monocular condition and cannot affect both eyes
- **Amblyopia can be caused from strabismus, refractive error, and visual deprivation**

22. An 8-year-old boy presents with swelling around his right left eye as seen below. Ophthalmology is consulted and diagnoses orbital cellulitis. The best description of this condition is:



- An infection isolated anterior to the orbital septum
- **An infection that extends posterior to the orbital septum**
- An infection of the lacrimal sac
- A noninfectious obstruction of the Meibomian gland

23. The next appropriate step in management for this boy (from previous question) with orbital cellulitis includes:

- Warm compresses
- Intravitreal antibiotic injection
- Topical antibiotic drop
- **Intravenous (IV) antibiotics**

24. Which of the following muscles actively participates in elevation of the globe (looking upward)?

- **Superior rectus**
- Medial rectus
- Inferior rectus
- Mueller's muscle

25. A 70-year-old woman presents to the emergency room at midnight reporting sudden onset blurred vision, halos around lights, ocular redness, severe pain, and nausea/vomiting. This is the typical presentation of which of the following?

- Recurrent corneal erosion
- Acute anterior uveitis
- Scleritis
- **Acute angle closure glaucoma**

26. A previously healthy 40-year-old woman presents with painless bilateral proptosis and eyelid retraction. The most likely diagnosis is:

- **Thyroid eye disease**
- Metastatic tumor of the orbit
- Orbital cellulitis
- Orbital pseudotumor

27. Parents present with their one-year-old child and report that the child is sensitive to light and he has constant tearing from his right eye. On examination, you note that his right eye appears larger than the left eye and there is an afferent pupillary defect in the right eye. Corneas are clear bilaterally and there is a good red reflex bilaterally. What is the appropriate next step in care?

- Perform exam under anesthesia to assess for patent nasal lacrimal duct
- Initiate amblyopia treatment
- Follow closely for resolution of afferent pupillary defect as child grows
- **Perform exam under anesthesia to assess intraocular pressure and assess optic nerves**

28. A 15-year-old complains of progressively worsening blurry vision in both eyes over the last two years which he notices at school looking at the board. Squinting improves his vision. He is not noticing difficulty with his reading vision. His problem is most likely to be:

- Presbyopia
- Astigmatism
- Hyperopia
- **Myopia**

29. What is the most common cause for nuclear sclerosis development?

- Trauma
- Corticosteroid use
- **Age**
- Smoking

30. A 52-year-old woman with a history of primary open-angle glaucoma calls your office because she purchased an

oral over-the-counter allergy medication for her allergic rhinitis. There is a package insert warning about taking this medication with glaucoma. What do you tell her?

- Advise her to take medication only if symptoms are severe and there are no other medication options available
- Advise her to not take the medication given her diagnosis of primary open angle glaucoma
- **Advise her that there is no contraindication to this medication with primary open angle glaucoma**
- Advise her to take half the recommended dosing to avoid complications

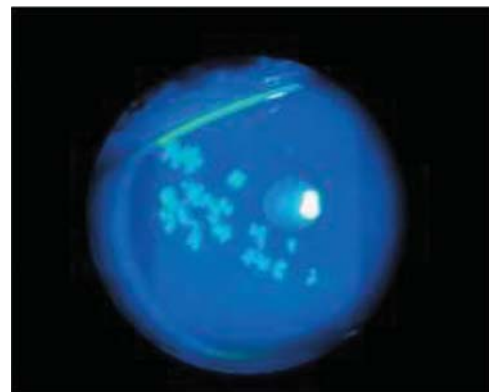
31. A principle side effect of topical ophthalmic anesthetic abuse is:

- Proptosis due to conjunctival congestion
- Permanent iris pigment change
- Loss of effectiveness
- **Corneal epithelial toxicity**

32. A 21-year-old college student was diagnosed with viral conjunctivitis in both eyes. Four weeks later, he presents again with continued symptoms including redness, irritation, and itching. What is the next reasonable step in diagnostic workup?

- Intraocular pressure measurements
- Systemic workup for underlying cause of uveitis
- Central corneal thickness measurements
- **Chlamydia cultures**

33. A 26-year-old woman presents with three-day history of painful red eye with photophobia. On examination, corneal sensation is decreased and the following is a photograph of the cornea after fluorescein installation. The following is the most likely diagnosis:



- Corneal abrasion
- Bacterial keratitis
- **Herpetic keratitis**
- Crystalline keratopathy

34. An infection involving the internal structures of the eye is called:

- Orbitopathy orbital cellulitis

- Uveitis
- **Endophthalmitis**
- Globe abscess

35. A 30-year-old man was moving a piano earlier in the day and presents with a non-painful, red eye. Which of the



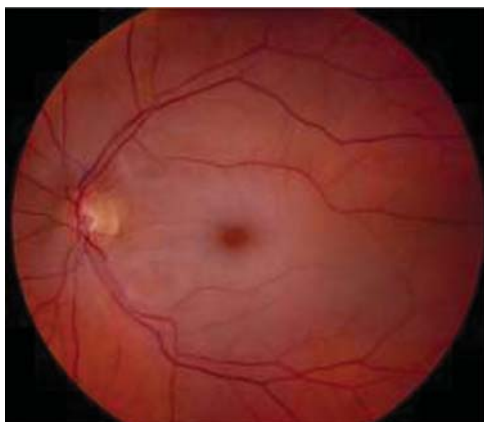
following statements is true regarding the following condition:

- It is a potentially serious melanocytic lesion that can lead to the development of melanoma
- It is an infectious cause of conjunctival inflammation
- It is a destructive, vision-threatening inflammation involving the deep episclera and sclera
- **It is a common, benign, self-limited condition with characteristic appearance of a sharply circumscribed redness of bleeding underneath the conjunctiva**

36. If a patient reads the eye chart better when looking through a pinhole occluder, this implies there is a problem with:

- Eye alignment
- **Refraction**
- Accommodation
- Optic nerve

37. A 70-year-old woman presents with sudden, painless vision loss in left eye. Visual acuity is light perception only and an afferent pupillary defect is noted in the left eye. Fundoscopic examination reveals the following:



Which of the following is the most likely diagnosis?

- Macroaneurysm
- Central retinal vein occlusion
- Subretinal neovascularization
- **Central retinal artery occlusion**

38. Cataracts often cause the following symptoms:

- Increased tearing
- **Glare and halo when driving at night**
- Eye redness
- Floaters

39. Ciliary flush is often an examination finding associated with the following condition:

- Viral conjunctivitis
- **Anterior uveitis**
- Vitreous hemorrhage
- Subconjunctival hemorrhage

40. A 30-year-old woman presents with bilateral red eyes with complaints of itching and discharge for 2 days. Of note, patient also reports an upper respiratory infection with stuffy nose and sore throat that started 5 days ago and her son had similar ocular issues last week. The recommended course of treatment is:

- **Topical artificial tear drop**
- Topical anesthetic drop
- Topical antiviral drop
- Topical antibiotic drop

41. A 40-year-old woman presents with a 3 day history of a red, tender right lower eyelid. Examination reveals a tender nodule of the right lower eyelid with minimal injection of the inferior conjunctiva. Which of the following is appropriate management by a primary care provider?

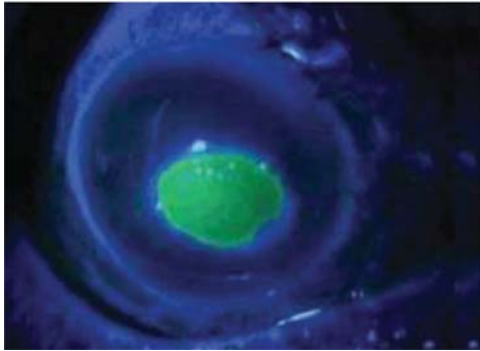
- **Warm compresses**
- Oral antibiotics
- Topical antibiotic drop
- Topical antiviral drop

42. A 95-year-old man who lives at a nursing facility present with red, irritated eyes that have been bothersome for months. He reports he has the sensation of sand in his eyes all the time. On examination, all eyelid margins show inflammation (redness) and are edematous with debris on eyelashes. The most common diagnosis is:

- Conjunctivitis
- Chalazion
- Symblepharon
- **Blepharitis**

43. An 83-year-old woman presents to emergency room after falling and hitting the left side of her face on the coffee table. She presents with a brow laceration, periorbital edema around the left eye, and numbness of her cheek on the left side. As the emergency room resident, the most appropriate next step in management is:

- Palpate the globe to see if patient has normal intraocular pressure
- Repair the brow laceration
- Send patient for CT scan to rule out retrobulbar hemorrhage
- **Carefully open eyelids to examine for ruptured globe**



44. A 29-year-old woman presents urgently after her toddler poked her in the right eye with a finger. She reports right eye pain, tearing, and blurry vision. The photo below show cornea with fluorescein staining.

The most appropriate treatment for this condition would be:

- Topical anesthetic
- Oral antibiotics
- **Topical antibiotic drop or ointment**
- Topical artificial tear

45. You are a primary care provider and a 70-year-old man with hypertension and diabetes presents to establish care. Patient reports that he has not seen an ophthalmologist in 5 years. He has never worn glasses and has no visual complaints, other than he wears over-the-counter reading glasses for near vision correction. What is the best recommendation you can make for this patient with regards to ocular health?

- Continue with over-the-counter glasses until distance vision becomes blurry
- **Refer to an ophthalmologist for complete examination**
- Determine how many years patient has been diabetic and if more than 10 years, then refer to ophthalmologist
- Perform an ocular examination in your office including use of direct ophthalmoscope to determine if patient has ocular disease

46. A 68-year-old woman had cataract surgery 2 weeks ago in the right eye. She presents urgently to the emergency room and ophthalmology is consulted. The patient is diagnosed with endophthalmitis. What are the common symptoms associated with endophthalmitis?

- Light sensitivity and black shade or curtain in vision
- **Decreased vision, ocular pain, and redness**

- Floaters and flashes of light
- Tearing and discharge from eye

47. You are a primary care provider and recently started a 30-year-old woman on topiramate for migraine control and treatment. She calls your office and reports she has sudden onset of bilateral blurry vision, eye redness, eye pain, and nausea. The most likely diagnosis is:

- Bacterial conjunctivitis
- **Angle closure glaucoma**
- Viral conjunctivitis
- Anterior uveitis

48. A 90-year-old woman presents with chronic left eye irritation. On examination you note that the lower eyelid is turning inward and the eyelashes are rubbing the corneal surface. This condition is called:

- **Entropion**
- Dermatochalasis
- Epiblepharon
- Ectropion

49. A 22-year-old woman presents with a one day history of a red, painful right eye. She reports that she wears soft



contact lenses and will often sleep with them in her eyes. The following photo represents her clinical examination.

What is the most likely diagnosis?

- Herpes keratitis
- Anterior stromal scar
- **Corneal ulcer**
- Epithelial downgrowth

50. A 40-year-old man reports that he has intermittent blurry vision that improves with blinking. On further questioning, he says that it only occurs at the end of a work day after using the computer for many hours. The most likely diagnosis is:

- Blepharitis
- **Dry eye syndrome**
- Cataract progression
- Presbyopia