



## Ophthalmology Objectives for Medical Students: Revisiting What Every Graduating Medical Student Should Know

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The burden of eye disorders and impaired vision in the United States is significant. Although ongoing prevalence studies estimating visual impairment in the United States need to be implemented, conservative estimates place direct medical costs at \$5.5 billion, whereas other analyses place the total economic burden at \$139 billion.<sup>1-4</sup> Ophthalmology-related issues arise in the diagnosis and treatment of inpatients and outpatients on internal medicine, pediatrics, trauma surgery, neurology, endocrinology, neurosurgery, otolaryngology, dermatology, oncology, and rheumatology services.<sup>5</sup> Prevalence of visual impairment in the United States is estimated at 7.5%, most of which is correctable, treatable, or preventable and is predicted to increase by 70% by 2020.<sup>6,7</sup> Nevertheless, ophthalmology is a required rotation in only 18% of medical schools.<sup>8</sup>

Most primary care program directors believe that fewer than 50% of incoming residents have sufficient ophthalmology skills when entering the internship period of medical education.<sup>9</sup> Ophthalmoscopy is one of many ophthalmic skills in which there seems to be a gap in the training of medical students.<sup>10</sup> The Fundus photography vs. Ophthalmoscopy Trial Outcomes in the Emergency Department (FOTO-ED) study demonstrated that emergency medicine physicians often do not perform an ophthalmoscopic examination when it is indicated, and when they do, they are unlikely to detect abnormal findings.<sup>11</sup> This presents a serious issue, because patients with visual impairments are more likely to be hospitalized, and from 2006 through 2011, there were 12 million eye-related emergency department visits nationwide.<sup>11,12</sup>

In 2009, Lippa et al<sup>13</sup> published an Association of University Professors in Ophthalmology (AUPO)-endorsed white paper outlining the ophthalmology competencies in core knowledge and examination skills that all medical students, regardless of their eventual specialty, should achieve before graduation. Since that time, the medical education environment has changed significantly. Medical education has become more

reliant on online interactive tools, flipped classrooms, and just-in-time education. There has been a movement toward more accurate assessment of students' achievement of learning objectives in an effort to ensure that they can be entrusted with patient care activities before graduation.

There is arguably a decreased need to learn the use of a direct ophthalmoscope as digital retinal photography becomes easier and less expensive to use. As digital photography becomes more prevalent in primary care practices and emergency rooms, the emphasis on skill acquisition in direct ophthalmoscopy may become less of a focus; however, we do believe that it is imperative that students know when it is important to examine the fundus. If they are unable to view or interpret fundus findings with

either an ophthalmoscope or fundus photography, the students must know when it is necessary to refer their patients to an ophthalmologist for further evaluation.

With these considerations in mind, we propose the adoption of a modified list of ophthalmology-related objectives for graduating medical students. These objectives were written by the authors, the members of the AUPO Medical Student Educators Council from 2016 through 2017. The Council began with the 2009 white paper<sup>13</sup> and earlier recommendations created by the AUPO in 1995.<sup>14</sup> The authors tasked themselves with the goal of updating the objectives for the current medical education environment. We surveyed the literature, reviewed and discussed with medical colleagues outside of our field, and then iteratively revised via e-mail and conference until consensus was achieved. In particular, the objectives were examined for importance and feasibility. The objectives were reviewed and endorsed without further revision by the Boards of Trustees of the AUPO and the American Academy of Ophthalmology (AAO). These 2018 guidelines are in the form of objectives that we hope that medical student educators can use directly in their curricula.

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At the highest level, the objectives are meant to be broad, simple, and familiar. The objectives can and should be used by any medical school, regardless of whether they have a department of ophthalmology. Many, if not all, of these objectives can be incorporated into the curricula of other specialties of medicine (e.g., neurology, family practice, internal medicine, and pediatrics).

The [Appendix](#) (available at [www.aaojournal.org](http://www.aaojournal.org)) contains a detailed list of objectives that may be used to create an ophthalmology curriculum for any medical school. The [Appendix](#) includes a complete list of concepts that can and should be divided among other medical specialties if necessary. Furthermore, the AUPO and AAO are in the process of creating an online resource that will aid schools with limited resources to achieve these objectives. An individual, preferably an ophthalmologist, should be identified at each medical school who is familiar with these core objectives and resources.

On graduation from medical school, the student should be able to (1) describe the anatomy of the eye and the visual system, (2) perform a basic eye examination, (3) evaluate a patient with acute painless vision loss, (4) evaluate a patient with chronic vision loss, (5) evaluate a patient with a red or painful eye, (6) evaluate a patient with eye trauma, (7) evaluate a patient with an eye movement abnormality or diplopia, (8) describe the important causes of vision loss in children, (9) describe the ocular manifestations of systemic disease, (10) list the most important ocular side effects of systemic drugs, (11) list the common ocular medications that can have systemic side effects, and (12) describe when it is necessary to refer a patient urgently to ophthalmology.

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## Appendix

- Describe the anatomy of the eye and the visual system
  - List the important structures of the eye | Resource: [Eye Anatomy Video](#)
    - External eye and adnexa | Resources: [External Landmarks and Extraocular Muscles](#), [Cross Section of Eyelid](#), [The External Eyelids](#), [Eyelid Margin Anatomy](#), [The Lacrimal Apparatus](#)
      - Conjunctiva
      - Sclera
      - Cornea | Resource: [Quiz on the 5 Layers of the Cornea](#)
      - Anterior chamber | Resource: [Anterior Chamber Angle and Ciliary Body](#)
      - Ciliary body and aqueous drainage system
      - Iris
      - Lens
      - Optic nerve
      - Retina | Resources: [Fundus Diagram](#), [The Retina at Its Junction with Optic Nerve](#)
      - Extraocular muscles | Resources: [Anatomy of the Extraocular Muscles](#), [External Landmarks and Extraocular Muscles](#)
        - Describe the location and function of these structures, and blood supply of the retina
  - Perform a basic eye exam | Resource: [Guide to the Bedside Ophthalmic Exam](#) | [Pediatric Eye Examination](#)
    - Measure and record visual acuity
      - Note whether acuity was measured at near or far
      - Note whether acuity was measured with or without correction
      - Remeasure acuity using pinholes when vision abnormal 2
    - Examine pupillary responses
      - Assess for an afferent pupillary defect | Resources: [Simulation of Pupillary Defects](#), [Anatomy of Sympathetic Pathway](#)

- Assess for pupil shape, size, and symmetry
  - Examine ocular motility
    - Demonstrate an examination for range and symmetry in the nine cardinal positions of gaze
    - Demonstrate the use of corneal light reflex or the cover uncover technique to assess for ocular misalignment
  - Assess visual fields by confrontation testing | Resources: [Field Defects](#), [The Visual Pathway](#)
  - Assess for severely increased intraocular pressure by palpation, when indicated
  - Examine the important structures of the anterior segment of the eye with a penlight in a systematic way
  - Examine the fundus with either direct ophthalmoscope or fundus photography and identify the most important structures
- Evaluate a patient with acute painless vision loss | Resource: [Sudden Vision Loss Case](#)
    - Obtain a focused history with regard to the timing, severity, monocular or binocular nature, pain or redness associated with the vision loss | Resource: [Management of Acute Vision Loss in ED](#)
    - Obtain a focused past ocular history relevant to acute vision loss
    - Obtain a focused systemic medical history relevant to acute vision loss
    - Perform a focused exam as outlined above
    - List and describe the pathophysiology of the important causes of acute vision loss including
      - Retinal detachment | Resource: [Retinal Causes of Vision Loss](#)
      - Retinal vascular events such as
        - retinal arterial occlusion | Resource: [Central Causes of Vision Loss](#)
        - retinal vein occlusion | Resource: [Retinal Causes of Vision Loss](#)
        - amaurosis fugax | Resource: [Central Causes of Vision Loss](#)

- Optic nerve insults such as | Resource: [Optic Neuropathies](#)
  - giant cell arteritis and non-arteritic ischemic optic neuropathy
  - compressive optic neuropathy
  - optic neuritis
  
- Describe the presenting signs and symptoms of these diagnoses and narrow a differential diagnosis based on the elicited history and exam
  
- Describe the initial management and urgency of referral for these diagnoses
  
  
- Evaluate a patient with chronic vision loss | Resource: [Chronic Vision Loss Case](#)
  - Take a focused history with regard to the timing, severity, monocular or binocular nature, pain or redness associated with the vision loss
  
  - Take a focused past ocular history relevant to chronic vision loss
  
  - Take a focused systemic medical history relevant to chronic vision loss
  
  - Perform a focused exam as outlined above
  
  - List and describe the pathophysiology of the common causes of chronic vision loss including
    - Refractive error - myopia, hyperopia, astigmatism, presbyopia | Resource: [Vision Loss and Refractive Error](#)
    - Cataract | Resource: [Vision Loss and Cataract](#)
    - Glaucoma | Resource: [Vision Loss and Glaucoma](#)
    - Macular Degeneration | Resource: [Vision Loss and Macular Degeneration](#)
    - Diabetic Retinopathy | Resource: [The Eye and Diabetes Mellitus](#)
  
  - Describe the presenting signs and symptoms of these diagnoses and narrow a differential diagnosis based on the elicited history and exam, understanding that some of these may present in an acute manner
  
  - Describe the management for these diagnoses by an ophthalmologist
  
- Evaluate a patient with a red or painful eye | Resources: [Painful Red Eye Case](#), [Painless Red Eye Case](#)

- Take a focused history with regard to the timing, severity, monocular or binocular nature or vision loss associated with the painful or red eye | Resources: [How to Distinguish Between Vision-threatening and Non-Vision threatening Causes of Red Eye](#)
  - Take a focused past ocular history relevant to painful or red eye
  - Take a focused systemic medical history relevant to painful or red eye
  - Perform a focused exam as outlined above and describe the pattern of redness | Resources: [Why Does the Eye Get Red?](#)
  - List and describe the pathophysiology of the common and important to not miss causes of a painful or red eye including | Resources: [How to Distinguish Between Vision-threatening and Not Vision-threatening Causes of Red Eye](#)
    - Blepharitis and dry eye | Resources: [External Causes of Red Eye](#)
    - Preseptal cellulitis and orbital infection
    - Conjunctivitis (allergic, viral and bacterial)
    - Subconjunctival hemorrhage | Resources: [Scleral and Conjunctival Causes of Red Eye](#)
    - Scleritis
    - Corneal Abrasion
    - Corneal ulcer (infectious - herpetic, bacterial, contact lens related)
    - Angle-closure glaucoma | Resources: [Anterior Chamber Causes of Red Eye](#)
    - Uveitis
    - Intraocular infection/endophthalmitis
  - Describe the presenting signs and symptoms of these diagnoses and narrow a differential diagnosis based on the elicited history and exam
  - Describe the initial management and urgency of referral for these diagnoses
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- Evaluate a patient with eye trauma | Resources: [Ocular Trauma Case](#)

- Take a focused history with regard to the mechanism of injury and associated pain or vision loss | Resources: [Assessing Eye Trauma](#)
- Take a focused past ocular story relevant to eye trauma
- Perform a focused exam as outlined above
- List and describe the common manifestations of eye trauma including
  - Corneal abrasion | Resources: [Trauma of the Anterior Segment Part 1](#)
  - Corneal foreign body
  - Corneal laceration (open globe)
  - Chemical injury | Resources: [Trauma of the Anterior Segment Part 2](#)
  - Hyphema
  - Ruptured globe
  - Vitreous hemorrhage | Resources: [Trauma of the Posterior Segment](#)
- Describe the presenting signs and symptoms of these diagnoses and narrow a differential diagnosis based on the elicited history and exam
- Describe the initial management and urgency of referral for these diagnoses
- Describe the importance of ruling out globe rupture before manipulating the eye
- Evaluate a patient with an eye movement abnormality or diplopia | [Double Vision and Neuro-Ophthalmology Case](#)
  - Take a focused history with regard to the timing, associated pain, redness or vision loss
  - List distinguishing characteristics of monocular and binocular diplopia | Resource: [Binocular vs. Monocular Diplopia](#)
  - Take a focused past ocular history relevant to diplopia and ocular misalignment
  - Perform a focused exam as outlined above | Resource: [Examination Maneuvers for Diplopia](#)

- List and describe the common manifestations of eye movement abnormalities including | Resources: [Brainstem Anatomy of the Cranial Nerves Involved in Eye Movement](#)
  - Cranial nerve paresis/palsy (CN 3, 4, 6) | Resources: [Cranial Nerve III Palsy](#), [Cranial Nerve IV \(Trochlear Nerve\) Palsy](#), [Cranial Nerve VI Palsy](#)
  - Thyroid eye disease | Resource: [Thyroid Eye Disease](#)
- Describe the presenting signs and symptoms of these diagnoses and narrow a differential diagnosis based on the elicited history and exam
  - Describe the initial management and urgency of referral for these diagnoses
- List and describe the pathophysiology of the most important ophthalmic problems in children including | Resources: [Pediatric Ophthalmology Case](#), [Leukocoria](#)
    - Refractive error
    - Amblyopia and strabismus | Resource: [Amblyopia](#)
    - Congenital cataract | Resource: [Pediatric Cataract](#)
    - Congenital glaucoma
    - Retinoblastoma | Resource: [Retinoblastoma](#)
    - Retinopathy of prematurity | Resource: [Retinopathy of Prematurity](#)
- Describe the ocular manifestations of systemic conditions including | Resources: [Diabetes and the Eye Case](#)
    - Diabetes | Resources: [The Eye and Diabetes Mellitus](#)
    - Hypertension | Resources: [Hypertension and the Eye](#)
    - Sickle Cell disease or trait | Resources: [Sickle Cell Retinopathy](#)
    - Human Immunodeficiency Virus/ Immunocompromised patients | Resources: [The Effects of HIV in the Eye](#)
    - Autoimmune conditions such as systemic lupus erythematosus, sarcoidosis, and rheumatoid arthritis | Resources: [Ocular Manifestations of Systemic Lupus Erythematosus](#), [Ocular Manifestations of Sarcoidosis](#), [Ocular Manifestations of Rheumatoid Arthritis](#)
    - Thyroid Eye Disease | Resources: [Thyroid Eye Disease](#)
    - Pregnancy | Resources: [Pregnancy and the Eye](#)
    - Neurologic conditions such as



- Cerebral vascular event
- Increased intracranial pressure | Resources: [Ocular Manifestations of Increased Intracranial Pressure](#)
- Giant Cell Arteritis
- List the most important ocular side effects of systemic drugs including | Resources: [Systemic Disease Case #2](#)
  - Corticosteroids (oral, topical, injected, inhaled) | Resources: [Ocular Side Effects of Corticosteroids](#)
  - Hydroxychloroquine | Resources: [Ocular Side Effects of Hydroxychloroquine](#)
  - Sympathomimetic & anticholinergic medications | Resources: [Ocular Manifestations of Autonomic Pharmacology](#)
- List the common ocular medications that can have systemic side effects
  - Topical beta blockers
  - Topical alpha-2 adrenergic agonists
  - Topical anticholinergics

Describe when it is necessary to urgently refer a patient to ophthalmology

- Eye pain
- Acute Diplopia
- Flashes/Floaters/Curtains
- Sudden Vision loss
- Concern for retinal/optic nerve abnormality not adequately visualized during ophthalmoscopic exam
- Concern for ruptured globe