



# Nurse Practitioner Students' Knowledge Assessment and Perceived Preparedness to Triage Ophthalmology Complaints in a Primary Care Setting: An Educational Intervention

Grace R. Reilly, MD<sup>1,2</sup> Nancy G. Russell, DNP<sup>3</sup> Kimberly McCltrot, DNP<sup>3</sup> Stephen D. Sisson, MD<sup>4</sup>  
Adrienne W. Scott, MD<sup>2</sup>

<sup>1</sup>Drexel University College of Medicine, Philadelphia, Pennsylvania

<sup>2</sup>Wilmer Eye Institute, Johns Hopkins University School of Medicine, Baltimore, Maryland

<sup>3</sup>Johns Hopkins University School of Nursing, Baltimore, Maryland

<sup>4</sup>Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland

**Address for correspondence** Adrienne W. Scott, MD, Retina Division, Wilmer Eye Institute, 600 N. Wolfe Street, Maumenee 719, Baltimore, MD 21287 (e-mail: ascott28@jhmi.edu).

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## Abstract

**Purpose** In this proof-of-concept pilot study, we aimed to increase nurse practitioner (NP) student knowledge of ophthalmology to prepare NPs for encounters in primary care settings. The Association of University Professors of Ophthalmology (AUPO) and the American Academy of Ophthalmology (AAO) endorse core knowledge that medical students should achieve. We assess the effectiveness of an innovative ophthalmologist-led curriculum based on these competencies tailored to issues NPs encounter in primary care.

**Methods** Johns Hopkins University NP students enrolled in a pre–post-cohort study and educational intervention. The didactic program was developed according to AUPO and AAO core ophthalmology content for medical students and was taught in-person by an ophthalmologist. Pre–post-assessments evaluated students' perceived readiness to encounter ophthalmic issues in the clinic and baseline knowledge of core competencies of ophthalmology.

**Results** A total of 42 NP students were included in the analysis. NP students improved in core knowledge and readiness to encounter ophthalmology issues. After the educational event, there was a statistically significant improvement in students' ratings of preparedness to obtain a focused history, exam, perform initial management and decide the urgency of a referral for acute painless vision loss ( $p < 0.001$ ), chronic vision loss ( $p < 0.001$ ), or a patient with a red/painful eye ( $p < 0.001$ ). Students showed a statistically significant improvement in postdidactic event core ophthalmology knowledge assessment scores ( $p = 0.002$ ).

**Conclusion** Primary care NPs are increasingly the initial point of contact for patients with ophthalmic complaints, and thus, high-quality and thorough education regarding

## Keywords

- ▶ Nurse practitioner
- ▶ ophthalmology education
- ▶ primary care
- ▶ interprofessional
- ▶ medical education

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ophthalmology triage and referral for NPs is necessary. NP student comfort with and knowledge of ophthalmic complaints and triage may be improved by a brief educational intervention taught by an ophthalmologist early in the NP curriculum.

Eye disease and vision impairment are significant causes of disability in the United States with 1 in every 28 Americans over the age of 40 years being affected.<sup>1,2</sup> Individuals across all ethnic and racial groups describe the loss of eyesight as the worst ailment that could befall them relative to losing memory, speech, hearing, or a limb.<sup>3</sup> Protecting eye health requires prompt triage and referral. In the United States, primary care providers serve as the front line for preventive medicine and as “gatekeepers” to accessing specialists in a managed care system.<sup>4</sup> The primary care workforce is changing, with the number of nurse practitioners (NPs) expected to grow by 6.8% each year from 2016 to 2030, while the number of physicians is increasing by 1.1% each year.<sup>5</sup> The number of NPs is growing most rapidly in the primary care setting.<sup>5,6</sup>

NPs are increasingly the first point of contact to triage patients' eye complaints and decide when referral to an ophthalmologist is needed. Ophthalmology complaints commonly arise in many practice settings including inpatient and outpatient services.<sup>7</sup> There has been a call to increase NP ophthalmic competency by addressing educational practice gaps, with the goal of strengthening the provision of eye care in independent practice.<sup>6</sup>

High-quality NP education follows the standards and competencies set forth by the American Association of Colleges of Nursing and the National Organization of Nurse Practitioner Faculties.<sup>8,9</sup> The Association of University Professors of Ophthalmology (AUPO) and the American Academy of Ophthalmology (AAO) have endorsed core ophthalmology knowledge and examination skills that all medical students should attain prior to beginning a residency in any specialty.<sup>10</sup> These competencies were put forth in response to a number of calls to action to improve ophthalmology education for medical students and primary care physicians.<sup>11-13</sup> Therefore, we used the competencies outlined by the AUPO and AAO as a framework for specific ophthalmology competencies NP students should achieve at our institution. To our knowledge, to date, there has not been any research published on NP student ophthalmology education and perceived preparedness to triage ophthalmology issues in a clinical setting. Therefore, in this proof-of-concept pilot study, we assessed the current attitudes toward the perceived readiness of a group of novice NP students to encounter ophthalmology issues in a clinical setting and evaluated the effectiveness of an innovative ophthalmologist-led education curriculum based on the knowledge competencies outlined by the AUPO and AAO for all medical school graduates.

## Methods

### Study Population

NP students who participated in a mandatory in-person ophthalmology education event as part of a required diagnos-

tic and procedural skill course were recruited for this pre-post-cohort study. The NP student participants were enrolled in at least one of the following NP programs within our institution's School of Nursing: Adult Gerontological Acute Care, Adult Gerontological Primary Care, Family Primary Care, Pediatric Primary Care, and Pediatric Dual Primary/Acute Care. These NP students were early in their respective NP programs and had received some course instruction in basic eye anatomy but had not yet begun any clinical rotations. NP students attended one of two identical ophthalmology lecture-based events led by an ophthalmologist (A.W.S.) as a mandatory part of their school curriculum in May 2022. Two weeks prior to the event, students were recruited for study enrollment via an online post on the University Learning Management System. The study was approved by the Institutional Review Board of the Johns Hopkins University School of Medicine and follows tenets of the Declaration of Helsinki.

### Content Development

The content was developed according to AUPO- and AAO-endorsed core ophthalmology content for medical students as listed in the Appendix of Graubart et al (►Table 1).<sup>10</sup> We reviewed each of these objectives and identified the most critical information for a primary care NP (►Table 2). The didactic material focused on information that would help NPs identify which patients need an ophthalmology referral

**Table 1** AAO and AUPO endorsed ophthalmology objectives for medical students<sup>a</sup>

|    | Learning objective  |
|----|---|
| 1. | Describe eye and visual system anatomy.   |
| 2. | Carry out a basic eye examination.  |
| 3. | Assess a patient with each of the following:<br>a. A red or painful eye.<br>b. Eye trauma<br>c. Diplopia or eye movement abnormality<br>d. Acute painless vision loss<br>e. Chronic vision loss |
| 4. | List the important causes of vision loss in children.   |
| 5. | Describe the ocular manifestations of systemic disease.   |
| 6. | Name the most important ocular side effects of systemic drugs.  |
| 7. | Name the common ocular medications that can have systemic side effects.   |
| 8. | Describe when urgent referral to an ophthalmologist is necessary.   |

Abbreviations: AAO, American Academy of Ophthalmology; AUPO, Association of University Professors of Ophthalmology.

<sup>a</sup>AAO and AUPO endorsed ophthalmology objectives for medical students are explained in detail in the Appendix of Graubart et al.<sup>10</sup>

**Table 2** NP educational program content

| Program Topics                          | Descriptions   |
|---|--|
| Eye anatomy                             | Review of basic ocular anatomy   |
| Chronic vision loss                     | Cataracts, glaucoma, macular degeneration, and diabetic retinopathy  |
| Acute vision loss                       | Acute angle closure glaucoma, vitreous hemorrhage, retinal detachment, retinal vascular events, cerebral vascular events, and optic neuritis |
| Common ophthalmic infections and trauma | Conjunctivitis, periorbital and orbital cellulitis, endophthalmitis, corneal abrasion, and corneal ulcer                                     |
| Basic eye exam                          | Visual acuity, pupil exam, extraocular motion, intraocular pressure, and confrontational visual fields                                       |

based on the patient's presentation and history. We created a 45-minute lecture and 15-minute basic exam skills event which reviewed the topics listed in ►Table 2, addressing patient presentation and differential urgency of referral to an ophthalmologist for each topic.

### Survey Development

#### Attitude and Preparedness Self-Assessment Questionnaire

We used six questions to assess NP students' perceived preparedness and attitudes toward encountering ophthalmology issues in the primary care setting. Participants were asked to rate how prepared they felt on a Likert scale from 0 (low/unprepared) to 10 (high/very prepared) for each of six objectives. Objectives were based on the topics in ►Table 2 derived from the AAO/AUPO guidelines.<sup>10</sup> An identical questionnaire was used before and after the didactic event.

#### Ophthalmology Knowledge Assessment Questionnaire

The knowledge questionnaire included 10 multiple-choice questions (►Supplementary Material 1 [available in the online version]) on the topics in ►Table 2 identified from questions published by the AAO for public education use on their website.<sup>14</sup> To maintain pre-/post-test reliability in a one-time cohort study setting, the same questions were used in pre-/post-testing with the order of questions and responses randomized.

Both the attitude and preparedness and the ophthalmology knowledge questionnaires were reviewed by all authors including faculty experienced in medical education research. Study assessments were performed in a similar fashion to prior published studies.<sup>15,16</sup>

#### Data Collection and Analysis

Students enrolled in the study received the attitude and preparedness self-assessment questionnaire, knowledge questionnaire, and demographic questions in one multiple-choice Google Form for completion within a week prior to the didactic

**Table 3** Background and demographics of NP students

| <i>n</i> = 49                                 | No. (%)   |
|---|-----------|
| Exposure to ophthalmology prior to NP program |           |
| Yes   | 6 (12.2)  |
| No  | 43 (87.8) |
| Gender  |           |
| Female  | 43 (57.8) |
| Male  | 5 (42.2)  |
| Prefer not to respond                         | 1 (2.0)   |
| Ethnicity (multiselect)                       |           |
| White   | 34 (69.4) |
| Asian   | 11 (22.4) |
| Black or African Descent                      | 5 (10.2)  |
| Hispanic or Latino                            | 3 (6.1)   |
| American Indian or Alaska Native              | 1 (2.0)   |
| Other   | 2 (4.1)   |
| Age (years)                                   |           |
| Range   | 24–55     |
| Average                                       | 31.6      |
| Median  | 29        |
| No response                                   | 4         |

event. Posttests were sent out in the same online format to each participant immediately following the didactic event. Students were sent two reminders to complete the survey and response submission closed 1.5 weeks after the event. Statistical analysis was performed using *t*-tests on SPSS to compare pretest to posttest survey question scores. A power analysis was completed using SPSS, and the study sample size had sufficient power to achieve statistical significance.

## Results

### Nurse Practitioner Student Characteristics

In total, 49 NP students enrolled and completed the pretest questionnaire which was used as study data. Of the participants enrolled, 42 completed the posttest questionnaire (85.7%). Study participants were at an average age of 31.6 years (range 24–55). The majority were identified as female (57.8%) and white (69.4%). 87.8% (43) did not have any prior exposure to Ophthalmology prior to their NP program (►Table 3).

### Nurse Practitioner Student Attitudes toward Ophthalmology Readiness

At baseline, prior to the ophthalmology education event, students' perceived readiness to encounter all six competencies outlined in ►Table 4 was on average 4.75 out of 10, ranging from 0 (low/un-prepared) to 10 (high/very prepared). Students reported feeling relatively most prepared to describe the anatomy of the eye (5.35) and least prepared to evaluate a patient with acute painless vision loss (4.06).

**Table 4** Ophthalmology readiness questionnaire items ( $n = 42$ )

| NP students rated how prepared they felt to perform the below on a scale from 0 (low/unprepared) to 10 (high/very prepared)         | Pretest mean (SD) | Posttest mean (SD) | Two-sided <i>t</i> -test |
|---|-------------------|--------------------|--------------------------|
| 1. Describe the anatomy of the eye  | 5.17 (1.53)       | 7.74 (1.36)        | <0.001                   |
| 2. Perform a basic eye exam   | 4.71 (1.74)       | 7.90 (1.34)        | <0.001                   |
| 3. Evaluate a patient with acute painless vision loss (obtain a focused history, exam, initial management, and urgency of referral) | 3.76 (1.56)       | 7.38 (1.40)        | <0.001                   |
| 4. Evaluate a patient with chronic vision loss (obtain a focused history, exam, initial management, and urgency of referral)        | 3.76 (1.45)       | 7.40 (1.34)        | <0.001                   |
| 5. Evaluate a patient with a red or painful eye (obtain a focused history, exam, initial management, and urgency of referral)       | 4.66 (2.04)       | 7.64 (1.43)        | <0.001                   |
| 6. Decide when it is necessary to urgently refer a patient to an ophthalmologist  | 4.74 (1.81)       | 8.05 (1.32)        | <0.001                   |

Abbreviation: SD, standard deviation.

Following the educational event, students had a statistically significant ( $p < 0.001$ , by paired *t* test) improvement in their perceived readiness to encounter each of the six competencies. The relative greatest improvement was reported in readiness to "Evaluate a patient with acute painless vision loss" ( $p < 0.001$ ) and "Decide when it is necessary to urgently refer a patient to an ophthalmologist" ( $p < 0.001$ , ► **Table 4**).

### Assessment of Nurse Practitioner Student Ophthalmology Knowledge Competencies

Students' baseline scores on the 10-question quiz to evaluate ophthalmology knowledge was 48.1%. Students showed a statistically significant improvement in postdidactic event test scores to 58.33% ( $p = 0.002$ , ► **Table 5**).

## Discussion

We evaluated NP student comfort with and knowledge of ophthalmic complaints and triage with a brief educational intervention taught by an ophthalmologist early in their curriculum. Among NP students studied, very few had any prior exposure to ophthalmology before entering NP school (6%,  $n = 12$ ). Though NP students at our institution had received basic eye anatomy instruction and receive additional ophthalmology education in their later curriculum, this educational intervention served as the only ophthalmology-dedicated didactic event and the only didactic taught by an ophthalmologist. Prior to the education event, students' perceived preparedness to obtain a focused history, exam, perform initial management, and decide the urgency of referral for acute painless vision loss (4.06), chronic vision loss (4.08), or a patient with a red/painful eye (4.92) was low. Following the educational event, there was a statistically significant improvement

in all students' ratings of preparedness to encounter the ophthalmology issues assessed. The greatest change in self-reported readiness was for readiness to evaluate a patient with acute painless vision loss and to decide when an urgent referral to an ophthalmologist is necessary. Students' pretest to posttest score improvement on the ophthalmology knowledge test was statistically significant. Students showed an average of 10.23% improvement in scores, which is equal to answering one additional question correctly on the posttest.

In 2009, Mottow-Lippa<sup>17</sup> published the first ophthalmology competencies endorsed by the AUPO for medical student graduates to attain. This publication was in response to multiple editorials calling for action in medical school ophthalmology education and a study of primary care program directors citing that fewer than 50% of incoming residents have sufficient ophthalmology skills when entering their first year of residency.<sup>13</sup> These competencies were updated in 2018,<sup>10</sup> but the primary care provider workforce has drastically changed over the last 10 years and is expected to continue to change with the number of NPs growing by 6.8% each year.<sup>5</sup> The updated AUPO/AAO medical student competencies state that it is preferable that an ophthalmologist lead the teaching to medical students.<sup>10</sup> Interprofessional collaboration in education is an important component of a collaborative practice environment and is recommended for health professionals.<sup>18,19</sup> Ophthalmologists can share their expertise and collaborate with NP faculty to bring high-quality ophthalmology education to NP students.

Our study had several limitations due to its design as a single institution proof-of-concept pilot study. The study was limited by the time allotted for the educational intervention (1 hour) and the willingness of students to voluntarily complete pre- and posttests without external incentive. For this reason, the number of survey questions was limited to 10 knowledge and 6 perceived preparedness questions. The questionnaires students completed were subjective in nature and did not provide objective data on participant clinical preparedness or improvement in patient care. This type of subjective data collection is common in medical education and provides a groundwork for future studies.<sup>15,16,20</sup> Students who were willing to participate in the study may have had a higher degree of interest in ophthalmology than their peers

**Table 5** Ophthalmology knowledge questionnaire results

| $n = 42$       | Percent correct (%) | Two-sided <i>t</i> -test |
|----------------|---------------------|--------------------------|
| Pretest score  | 48.10               | 0.002                    |
| Posttest score | 58.33               |                          |

and therefore biased the cohort questionnaire results. Additionally, the timing of students completing the posttest varied from immediately following the didactic to 1.5 weeks postdidactic which may have influenced material retention. However, posttest score improvement was statistically significant.

The NP students in our study sample were early in their curriculum and, therefore, may have had minimal knowledge of ophthalmic triage, diagnosis, management, and referral criteria. The NP learners had completed the Advanced Health Assessment and Measurement course in their curriculum prior to this study but had not yet completed courses in their respective curriculums that address ophthalmology complaints, management, and referral. NP students at our institution receive additional ophthalmology education later in their curriculum as part of head, eye, ear, nose, and throat didactics. Students may benefit from additional time studying the material presented in the 60-minute didactic session, or the topics covered (► **Table 2**) were not fully assessed in a 10-question multiple-choice format. Student learning style was also not considered. The lecture-based format included a PowerPoint visual aid, which would benefit students with an auditory and visual learning style but does not account for students who prefer alternative learning styles including reading/writing.<sup>21</sup>

Primary care NPs are increasingly the initial point of contact for patients with ophthalmic complaints, and thus, high-quality, and thorough education regarding ophthalmology triage and referral for NPs is necessary. This proof-of-concept pilot study is the first, to our knowledge, to assess ophthalmology education for NP students and to have been designed and taught by an ophthalmologist. NP students' self-perceived preparedness to encounter ophthalmology issues improved after a brief educational intervention taught by an ophthalmologist. Following these positive preliminary results, future research should consider repeating posttest questionnaires after NP students receive additional clinical training to assess their retention of the material and attitudes toward readiness closer to the start of their independent practice. Ultimately, this study shows the positive impact of an intervention on NP students early in their curriculum. Later in curriculum and in clinical practice, NPs would benefit from continuing education in ophthalmology in collaboration with AAO educators.

Interprofessional collaboration in education is vital in preparing health professionals to best respond to patient needs.<sup>19</sup> Ophthalmologists have valuable expertise to share with NP students and can collaborate with NP educators, as in our study, to provide ophthalmology education that best meets the learning needs of primary care NP students.

#### Conflict of Interest

None declared.

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