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Ophthalmic Nursing Education: The Key to Unlocking Patient Access to Retina Services

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Acknowledgements

This project would not have been possible without the support of many people.

Abstract

Background: An entire field of healthcare is often overlooked and understudied in nursing education. Ophthalmology, the medical field dedicated to care of the human eye and visual system infrequently uses nurses due to a lack of nursing knowledge about ophthalmology. This disconnect, at a time when an aging population requires more ophthalmic care has led to staffing shortages and patient access issues.

Local Problem: An ophthalmic microsystem in the Northeastern United States is experiencing increased demand for services at the same time as they are seeing decreased access to their retina section. At present, the microsystem does not utilize nurses in the clinical environment because of education and training barriers. The specific aim of this quality improvement project is to increase nursing knowledge about ophthalmology from baseline to an overall passing score of 80%. Secondary aims are to assess participant perception of the learning modality, participant engagement and participant assessment of the strengths and weaknesses of the project.

Methods: This quality improvement project sought to see if registered nurses could improve their knowledge of ophthalmology over the course of four weeks with asynchronous, virtual, self-directed learning modules derived from texts provided by the American Society of Ophthalmic Registered Nurses (ASORN). Participants completed learning modules about anatomy and physiology of the human eye, ophthalmic nursing assessment and ocular manifestations of systemic illnesses.

Results: Eleven volunteers completed all aspects of this quality improvement project, including taking project specific testing instruments to set a baseline *pre-intervention* score, with a mean score of 42.54 out of 100 (SD=7.1, Range=0-100). They also took a *post-intervention*

assessment, with a mean score of 77.81 out of 100 (SD= 13.1, Range = 0-100). This quality improvement project found that the mean test score change was statistically significant for the quality improvement project (P<0.05).

Conclusions: Asynchronous virtual learning has the potential to improve ophthalmic nursing education over the course of four weeks. The conceivable utilization of this modality to educate nurses as a member of the ophthalmic services team is a viable option to possibly alleviate constraints on patient access to retinal services. It also identifies areas to develop further Plan, Do, Study, Act cycles in future quality improvement projects, like development of necessary psychomotor skills.

Keywords: ophthalmology, nurse, patient access, asynchronous virtual learning

Introduction

Nursing schools graduate about 155,000 registered nurses (RNs) each year (Salsberg, 2018). Often people describe nursing as a calling, a profession meant for empaths and those trying to alleviate a modicum of human suffering. All these graduates await a job market that is desperate for more nurses and many graduates will head off to medical surgical units in hospital systems. They may well forget many of the lectures that they endured while in school, becoming experts in fields like urologic nursing, intensive care nursing, but few will venture into the realm of ophthalmic nursing.

Ophthalmology is the healthcare field that deals with the health of the human eye. Despite being the second most complicated part of the human body, little attention is paid to educating nursing students about the human eye while they are in nursing school (Awh & Wilson, 2020). This leaves an entire field of healthcare reliant on training staff within the clinical setting to provide care for patients with chronic, vision-threatening, eye conditions. Given the enhanced scope of practice that a registered nurse could potentially bring to the ophthalmic clinical setting, it would behoove ophthalmologists and practice managers to consider the use of registered nurses to expand access of care to patients through ophthalmic nursing.

The question is still what to do about the needed education for nurses to be able to function competently within the team environment in an ophthalmology clinic? This quality improvement project proposed that current registered nurses can expand their working knowledge of ophthalmic conditions and nursing assessments via self-paced learning modules. Self-directed learning would allow ophthalmic clinics to integrate nurses into the clinical setting as an essential part of the team and provide them an education proper enough to facilitate relief to providers and patients alike.

Problem Description

The American population is aging. Every seventh person in the United States is over the age of 65, by 2040 the number of people over the age of 65 is expected to reach 80.8 million people, and in an additional 20 years will account for one quarter of the population of the United States (Centers for Disease Control, 2022). The youngest group of the *Baby Boomer* generation will reach 65 by the end of 2029 (Centers for Disease Control, 2022). By 2050 it is expected that the number of American adults with visual impairment will increase from four million to eight million (DeMott, 2016). Age related eye conditions like macular degeneration, which, if untreated can lead to low-vision and blindness, is expected to increase from 196 million worldwide in 2020 to 288 million by 2040 (Wong et al., 2014). Similarly, diabetes, the leading cause of blindness in adults under the age of 55, will increase in the world population from 463 million people in 2019 to 700 million people by 2045 (Teo et al., 2021). Other age-related eye conditions are also expected to increase over time as the population ages and these patients will need care (Klein & Klein, 2013). Delays in patients receiving care is associated with worse outcomes over time and in some instances visual acuity that is lost is not likely to return, decreasing patient quality of life and increasing needs for social welfare programs to supply support to these patients (Foot, 2017).

Local Problem

The eye clinic at a macrosystem in the Northeastern section of the US is the only practice within a rural area to supply eye services and support across all eleven of the ophthalmic subspecialties. Its busiest service is the retina service which provides care to patients experiencing issues like retinal detachments, retinal tears, macular degeneration, diabetic

retinopathy, vein occlusions and other conditions associated with the retina. The service is led by two physicians who have a full day in the operating room per week, plus the responsibility of providing care to patients with active vision threatening conditions. As of August 2021, one physician, is unable to see any new patients with conditions like macular degeneration or diabetic retinopathy because of their need for recurrent intravitreal injections to support visual acuity. The other provider has reached a similar juncture where most of their appointments seen during clinic require some degree of treatment and is unable to care for any new patients with macular degeneration or diabetic retinopathy since January 2022. The microsystem continues to see increased need for services from the community and to have one provider unable to evaluate new patients and another provider reaching that point, a large onus is falling on the patients and their personal support that are required to travel further distances to receive care, and to do so at regular intervals.

There has been a 59% increase in scheduled appointments in the retina service from 2012 to 2021, save for one period when a provider left. Demand for services is likely much higher for this service, but data was unable to be obtain for this metric. Clearly, though, a demand exists for patients within the communities of the Northeastern United States for the retina services of the microsystem. Limiting access to patient care because of provider unavailability causes delays in care that do not benefit patients, however forcing providers to see more patients than they can accommodate also does not benefit patients because there are downstream effects like increased wait times that also negatively affect patient experience. Historically, the microsystem has not used nurses in the clinical space because they have not had a need for healthcare practitioners with expanded scopes outside of the technical staff. Due to the complexity of patients, their increased need for services, increased need for intravitreal injections and limited provider

availability, it is time to provide education to nurses and to introduce nursing to the microsystem in consideration of a new role that facilitates increased patient access to those that need it desperately.

Available Knowledge
Disease Burden in Ophthalmology

While ophthalmology centers around the care of the eye, it has eleven subspecialties focusing on different parts of the eye. Given that intravitreal injections are the most common procedure performed in ophthalmic clinics today, diseases of the retina were focused on as the area where maximal impact may be seen with a nurse in a role as a physician extender (Hsu, 2022).

Age-Related Macular degeneration (AMD) is one of the leading causes of blindness in the developed world, particularly in adults over the age of 60 (Wong et al., 2014). In a systematic review and meta-analysis Wong et al. (2014) found that 8.7% of all blindness in the global population is attributed to macular degeneration. Their analysis suggests that the global disease burden of AMD is 196 million people in 2020 with an increase to 288 million by 2040 (Wong et al., 2014). Study findings also suggest a higher incidence of early and late AMD in people of European descent than in people of African, Hispanic, or Asian descent. The analysis is robust, with inclusion of thirty-nine studies used in the data aggregation. Limitations to the study suggest that there is difficulty parsing the difference between AMD and polypoidal choroidal vasculopathy, which manifest in similar fashion within the eye. Another weakness was ethnicity data, as only eight studies specifically controlled for ethnicity. The study shows that global prevalence of AMD is increasing, particularly among people of European ancestry when

compared to other ancestries, suggesting greater need for development of eye programs to address increased demand for ophthalmic services.

In another systematic review and meta-analysis Teo et al., (2021) looked at the global prevalence of diabetic retinopathy (DR) with projections through 2045 and its implications for practice changes. Again, this is a robust study with the inclusion of fifty-nine population- based studies, finding that in individuals with diabetes 22.27% had a positive finding of DR (95% confidence interval) (Teo et al., 2021). Findings note that 150 million people worldwide are affected by some form of DR and that number is expected to increase to 234 million people by 2045 (Teo et al., 2021). The disease burden falls on the African continent (35.9%), the American continent (33.3%) and was found to be the lowest in Central and South America (13.37%) (Teo et al., 2021). Limitations of this meta-analysis include no age-related data as a variable within the study, no indication of the duration or severity of diabetes, and although Africa was estimated to be the area of highest prevalence limited studies were collected from the African continent. The study finds that one out of every five people with diabetes worldwide will develop or present with DR. Suggesting a greater need for education, surveillance, and screening for this condition as it is the greatest cause of vision impairment in working age adults (Teo et al. 2021).

In a systematic review and meta-analysis Song et al. (2019) examined the global epidemiology of retinal vein occlusion (RVO). The primary risk factor identified is age, with adults aged 60-69 contributing the most cases for any RVO and adults 70-79 contributing the most cases to central retinal vein occlusions (CRVO) (Song et al., 2019). Disease prevalence was found to be twenty-eight million people, with age being the primary risk factor, but five subfactors identified include: hypertension, heart attack history, stroke history, higher level of total cholesterol and higher level of creatinine (Song et al. 2019). A shortcoming of the study is

that it supplies no projection for future rates of RVO and although it includes twenty-two studies,

seventeen of them did not provide any geographic breakdown. Although no projection was

provided, the Centers for Disease Control and Prevention note that one out of every two adults in

the United States has hypertension, putting them at increased risk of RVO (Health and Human

Services, 2021).

Each of these articles underscores the primary concept that ophthalmic care and needs are

increasing globally and thereby also increasing within the United States. According to research

from Burton et al. (2021), most individuals in the population will experience some degree of

visual impairment in their lifetime.

Challenges in Staffing and Nurses Roles in Ophthalmology

Supply of ophthalmic personnel is unable to meet current demands, particularly in the

face of rising disease burden and demand for services via an aging population (Burton et al.,

2021). A critical analysis is necessary to determine the need for increased nursing support in

ophthalmology as a method to bridge the gap between care demand and care provided.

Traditionally nurses in ophthalmology have roles that are primarily limited to the

operating theatre, with patient support roles being filled by Allied Health Personnel traditionally

known as ophthalmic assistants and technicians. With an aging population the need for

ophthalmic care is projected to increase over the next twenty years (Ansah et al., 2019). With

this increase in demand for ophthalmic care, the current supply of medical personnel, which

included doctors, nurses and allied health professionals is inadequate to support current

projections. This suggests that more professionals need to be educated to meet the needs of the

populace. This is supported by evidence that is found in a simulation model performed by Ansah

et al. (2019) involving key stakeholders in the ophthalmic care process, like ophthalmologists, nurses, managers, and technicians; the model projects the future needs of ophthalmic nurses and technicians. This model suggests a need for a 200% increase in available ophthalmic nurses and a 250% increase in need for ophthalmic technicians just to meet current demand placed on the system by 2040, if rates of ophthalmic care remain static (Ansah et al., 2019). If the rates increase, as they are projected to, an increase of 400% and 475% is indicated (Ansah et al., 2019).

Educational Demands of Ophthalmology

Education is an area of immense importance when it comes to ophthalmology. The eye is the second most complicated part of the human body, with two million moving parts. In a survey conducted by Rattanasirivilai and Shirodkar (2021) of ophthalmic nurses in the United Kingdom, it was noted that 63% of respondents found that formal education on ophthalmic nursing was limited. In a detailed internet search no programs to train ophthalmic nurses were identified. Only 2% of respondents to Rattanasirivilai and Shirodkar's survey (2021) suggested that they received any formal education in ophthalmology during their nursing school, where 98% of respondents identified that they were trained on the job by other nurses or physicians. Hessburg (2018) also underscores the idea that training of nurses and physician assistants (PAs) needs to be considered as many of them are trained on the job and given the shorter period of formal education. Utilizing these trained healthcare professionals can allow them, as physician extenders, to help overcome the gap in providers and the number of people that require care. Lee et al. (2020) found that physician assistants required an extra seven months of training in ophthalmology before they were able to work independently in a clinic. This indicates that

formal training programs may be needed to further expand the pool of applicable candidates that might benefit the ophthalmic community in the United States.

In research from Persaud-Sharma and Hooshmand (2021) they found an absolute paucity in training programs that exist for nurse practitioners (NPs) in ophthalmology. Hessburg (2018) and Persaud-Sharma and Hooshmand (2021) indicate that while medical residents may be a cost-effective option for reducing burden of care, they require generally higher oversight than nurses and physician assistants. Limitations are also placed on medical resident's clinical presence, related to research time and surgical training. Nurses and physician assistants are superior options to reduce care burden. The scarcity of training programs in the post-graduate period for RNs, NPs or PAs further emphasizes the need for training programs in the United States.

Hadavand et al. (2013) found that nurses could be integral to clinical efficiency and patient satisfaction within the ophthalmic setting. Nurses can be used in a variety of situations including education of patients about eye conditions, performance of assessments of visually impaired patients and making referrals to state and national organizations for low vision and the blind. Nurses can also help identify conditions like diabetes and hypertension that may impede or delay surgical interventions and allowing providers to see more complex patients by caring for established but stable patients (Hadavand et al., 2013). The idea that ophthalmic nurses expand patient access in critical areas is reaffirmed repeatedly throughout the literature, seen in arguments by Kim et al. (2018), Gallagher (2017), Nago (2015), Samalia et al. (2016) and Bolme et al. (2019). While all this evidence and editorial does exist, there still is an absolute shortage of nurses and other mid-level providers that are available to provide ophthalmic services to the public.

Nurse Delivered Intravitreal Injections

As stated by Hsu (2022) intravitreal injections (IVI) are the most common in office procedure done by ophthalmologists in the United States today. The National Institutes of Health projects increased need for these procedures as the population ages (Vo et al., 2021). According to research from Vo et al., (2021) the annual increase in IVI performed is 6% per year with only a 2.3% increase in ophthalmic proceduralists per year, leaving a gap of 3.7% or 112,198 IVI left to be administered (Vo et. Al., 2021). Of the proceduralists that provide IVI to patients throughout the year, the majority are ophthalmologists, with only 0.02% of injections being given by non-physicians (Physician Assistants and Nurses) (Vo et. Al., 2021). With growth in the need for these treatments and with increased difficulty in staffing throughout medicine and particularly in rural areas (Rural Health Information Hub, 2020) this represents an increase treatment burden with few indications of relief to providers.

Throughout the world, this treatment burden, scarcity of staffing resources, and increased demands have led healthcare systems to consider alternative ways to increase access of care to patients. The United Kingdom, New Zealand, Singapore, and Norway have all introduced nurse led IVI services reporting improved access to care while maintaining safety within expected norms (Austeng et al., 2016; Bolme et al., 2021; Kelly et al., 2014; Raman et al., 2020; Teo et al., 2020). This has also allowed providers attached to these services to refocus their attention on patients with complex retinal pathology who otherwise would have had to delay care until an appointment was available.

While examining the impact that nurse-led clinic has had on populations internationally, it is reasonable to consider the implications of the same practice in the United States. The Board

of Nursing (BON) in Ohio has examined the implications and have determined that it is within

the scope of practice of a registered nurse to perform the procedure of an intravitreal injection

(Ohio Board of Nursing, 2016). The BON does place some conditions and guards in place for the

safety of the patient, the ophthalmologist, and the nurse. First, the patient remains in the care of

the ophthalmologist, they are dictating the care plan and the nurse is conducting the care plan.

Second, the nurse is not making decisions on medication usage or dosage, this is determined by

the physician care plan. Third, the nurse has received proper training on eye anatomy and

complications associated with the delivery of medications intravitreally. Fourth, an

ophthalmologist is immediately available in the instance of any complications that may occur.

Patient Perspective

In research from Long et al. (2016) it has been noted that patients in ophthalmology value

two things above all others when it comes to overall satisfaction with their appointments. They

value time spent with a provider and ease of appointment scheduling over every other metric

available via a Press Ganey Survey (Long et al., 2016). As indicated above, nurses when acting

in the role of a physician extender provide increased face time with patients and increased access

to appointments, thereby addressing the two metrics that patients value.

In a randomized clinical trial that examined patient satisfaction with nurse-led IVI clinics,

Mohamed et al. (2018) found some interesting results. 85% of patients interviewed found that

they had no preference in who delivered their IVI, noting that there was no difference in the

technical proficiency, time spent with the patient, pain during or after the procedure, and

communication during the procedure (Mohamed et al., 2018). Raman et al. (2020) found in a

safety audit following 10,000 IVI of a medication called dexamethasone by training ophthalmic

nurses, used to treat recurrent edema in ophthalmic patients, that patient satisfaction remained high, and they encouraged the nurse-led clinics to continue. These examples underscore the significant impact that nurses can have on the ophthalmic community by expanding access to care and maintaining high levels of patient satisfaction with services delivered.

The most pressing driver of this is the need for expanded access. In a survey by Foot and MacEwen (2017) delays in care for patients were often associated with follow-up appointments occurring after the clinically recommended time, delay in appointment booking related to service capacity, lost referral, and delay of treatment. In all these cases patients were found to have lost sight because of delays in care. With the future of ophthalmic care in New England following the national and international trend of an aging populace with limited capacity, we do not have the luxury of delaying much longer. Rather the microsystem should implement the changes based on quality improvement guidelines and begin preparing the nurse for these new roles in ophthalmology.

Summary of Evidence

The global prevalence of ophthalmic conditions is due to increase over the next 20 years. This is in part due to the aging of the global population. Concurrently there has been an increasing disparity between the number of ophthalmic service providers and patients widening over the last twenty years. The role of ophthalmic nurses has been well established internationally, with nurse-led ophthalmic clinics having been developed in the United Kingdom, New Zealand, Norway, Singapore, and Sweden. The safety and efficacy of these clinics is well established and is non-inferior to physician delivered treatment, suggesting that this can be done safely in the United States. Patient satisfaction with nurse delivered services is also robust, again

with patients overwhelming satisfied with the services. Internationally there is a call for greater education in ophthalmology in the fields of nursing and physician assistants, suggesting that either more training occur at the formal level or that post-graduate residency programs for nurses and physician assistants be developed. For individuals that already have significant training in ophthalmology, specifically allied health personnel like ophthalmic technicians, training may even be abbreviated, and the Ohio Board of Nursing has already set precedent nationally by suggesting that registered nurses can perform IVI.

Implications for this Quality Improvement Project

The implications of this literature review for this quality improvement project serve to amplify the need of qualified advanced trained ophthalmic personnel to provide care to patients to overcome the challenges that currently being experienced in the medical community. The evidence shows that nurses can serve in the role physician extenders in ophthalmology. Nurses can provide direct care to patients under the supervision and guidance of trained ophthalmologists. Patients find nurse delivered care to be on par with physician deliver care. And the crux of the entire argument, the foundation of the PICOT question, nurses, when they work in ophthalmology can increase patient access to services, thereby reducing delays in care, thereby reducing the negative consequences of visual impairment. This potentially increases patient quality of life and overall satisfaction with healthcare systems. This review of knowledge shows that a critical area of focus to develop a nursing role in ophthalmology is within the domain of education, and this QI project developed educational modules for nurses that are interested in entering ophthalmology.

Rationale

Plan, Do, Study, Act (PDSA) was used as the rationale framework to guide this quality improvement project. PDSA is a tool often used in healthcare settings because it provides the structure to evaluate changes quickly. A need for expanded staffing solutions in ophthalmology was noted at the outset of this project development. The rationale for PDSA method utilization was that if the planned interventions were unsuccessful or partially successful, alterations could be made frequently during project timeline. The end goal of the PDSA model is the delivery of sustainable educational outcomes.

The planning stage of this project began in earnest in January of 2022 with the acknowledgement of the need for mid-level provider support in ophthalmology. Options were examined to develop physician assistant positions, nurse practitioner positions, and the needs that those positions could fulfill in the ophthalmic setting. While it may be desirable to find an internal candidate within the ophthalmology section to obtain the necessary degrees to provide support, it is not reasonable to expect non-licensed staff to always be available to obtain the requisite education required to be an RN, PA, or NP. A quality improvement plan was developed to survey current RNs about their ophthalmic knowledge, provide them with education and reassess their knowledge after the intervention.

The implementation phase of this QI project involved identifying ten current RNs to participate in a self-directed educational training program. The program was delivered over four weeks and involved a pre-training assessment of current knowledge in ophthalmology to set a baseline score for the participant. The training consisted of four recorded modules, one presenting information about the anatomy and physiology of the human eye; another on the nurse's assessment as outlined by the American Society of Ophthalmic Registered Nurses;

finally, two breaking down systemic disorders and their ophthalmic manifestations. Following the completion of all modules the RNs were given a post-training assessment to see how their scores differ from pre and post intervention.

The study portion of this intervention looked specifically at total precentage of score change. The expectation was that there will be a positive score change that is shown in the data. The participants were also asked to rate the training via project specific Likert and free-response assessment. This helped provide context to the project itself, highlighting areas to focus on for improvement in future iterations of this project.

The act portion of the intervention will involve dissemination of the findings to plan for future PDSA cycles in the quality improvement initiative such as the development of further educational modules or to look at more traditional methods of delivering training. More traditional methods could be the development of didactic course work in a classroom setting or training modules that are more granular in nature.

A Likert survey based off the Kirkpatrick Training Evaluation Model was used to determine volunteer perception of the intervention (Kirkpatrick Partners, LLC, 2022). The Kirkpatrick Model evaluates at four distinct levels: Reaction, Learning, Behavior, and Results (Kirkpatrick Partners, LLC, 2022).

Reaction is reported by the learner. Here the learner assesses their thoughts on the learning. How worthy of their time it was; how successful the training was and if the activities were engaging. Volunteers will use a pretraining assessment of the proposed learning subjects and a post-training assessment once the learning modules have been completed.

Learning relies on the assessments of the learner. Here volunteers will complete a pre-training test of knowledge to establish a baseline for learning and a final assessment at the end of the four weeks of training. This must also include an assessment of how comfortable the trainee might feel in their practice of the skills that they have learned via a Likert Score survey.

Behavior is a longer-term measure. Specifically, it refers to the utilization of the knowledge as it has been implemented by the learner. Given that the volunteers will likely not be working in ophthalmology this measure will be excluded from evaluation. Although, it can be included in later training if the ophthalmology service wishes to expand the pool of nurses that it utilizes in clinic.

Specific Aim

The primary aim of this QI project is to determine if, over the course of four weeks and with self-directed educational modules, an RN can increase knowledge of ophthalmology and ophthalmic nursing from their baseline score on the pre-training assessment to a score of at least 80% on the post-training assessment. The intervention involved the implementation of a project specific testing instrument and post-QI survey. Secondary aims were to: 1) assess the engagement of volunteers towards the course work, providing opportunities for further PDSA cycles and course improvement; and 2) assess nursing perceptions about the field of ophthalmology and the viability of nursing within the specialty.

Global Aim

The global aim of this project is to expand patient access to ophthalmic services via the creation of a new nursing position in ophthalmology, the Ophthalmic Nurse Specialist. This specialist will have the prerequisite knowledge, skills and professional comportment to function

as an integral member of the retinal services team and as the position develops in other subspecialties as well. This model has worked at another microsystem, dermatology, within the macrosystem, and has helped expand patient access.

Methods

Context
Cost Benefit Analysis

Ophthalmic services are increasing in demand throughout the world and throughout the nation. This is in part because the population is aging and with aging comes changes in the health of the human eye (*The Ophthalmology Workforce*, 2020). It is projected that the population over the age of 65 in the United States will increase by 48% over the next decade, with no equivalent growth in trained ophthalmologists over that same period (*The Ophthalmology Workforce*, 2020). This begets the question, if we have more people requiring health services, like ophthalmology, how do we ready a workforce to meet that demand? An avenue to consider would the use of specialty trained ophthalmic nurses, when trained appropriately, can act as physician extenders within the field to increase access to patient care.

Hessburg (2018) and Persaud-Sharma and Hooshmand (2021) indicate that while medical residents may be a cost-effective option for reducing burden of care, they require higher oversight than nurses and physician assistants. At present no training programs exist in the post-graduate period for RNs, NPs or PAs in ophthalmology and this further emphasizes the need for training programs in the United States. The cost benefit of hiring a nurse to act as a physician extender makes monetary sense, particularly if a skilled candidate already exists. In projections from Salary.com (2022) ophthalmic nurses have an average salary of $73,000 in the United States. According to Corcoran (2021) an average ophthalmic exam for a new patient reimburses

at $151.95 and established patient follow-ups reimburse at a rate of $114.87. If, conservatively, that nurse helped expand access to five new patients and 10 follow-up visits per week. If we account for the average reimbursement cost of an intravitreal injection, reimbursed at an average rate by Medicare of $402.00 then a nurse would need to expand access to 181 patients that require intravitreal injections (Centers for Medicare and Medicaid Services, 2022). Then a salary could be accounted for within 38 weeks

Given the increasing need for ophthalmic services, the lack of growth in ophthalmic providers and the difficulty in recruiting and retaining workforce in rural areas, it is prudent and fiscally responsible to hire a nurse to expand access to patient care in the field of ophthalmology. The nursing position has been evaluated by the finance department of the macrosystem and they have approved it in the ophthalmology budget for this fiscal year. In preparation and anticipation of this new role, substantial improvement needs to be made in ophthalmic nursing education.

Intervention

Through the literature review a few themes emerged as areas of intervention, perhaps the most pressing is the lack of education about ophthalmology that nurses receive while in their programs. The most robust resource for ophthalmic education was *Porth's Essentials of Pathophysiology*, which has 30 pages of information about ophthalmic conditions, but contains no information about ophthalmic nursing (Norris, 2019). In the ATI *RN Adult Medical Surgical Nursing Edition 11*, there is a chapter dedicated to disorders of the visual system but is only five pages long (Assessment Technologies Institute et al., 2019). Most importantly, in *Fundamentals of Nursing*, a textbook that is used throughout nursing programs in America, there are, roughly, six pages about caring for a patient's eyes (Taylor et al., 2015).

While completing a literature review, the articles that involved the creation of a *nurse injector* position, always began with education about the eye and ophthalmology as the primary part of the training. This intervention included the development of educational modules designed for entry-level nurses interested in the field. This required 15 current RN volunteers, not currently working in ophthalmology, to participate in this improvement project. The intervention included a pre-test assessment of knowledge about ophthalmology, ophthalmic conditions and nursing assessment findings based on the nursing assessment chapter in *The Essentials of Ophthalmic Nursing* from the American Society of Ophthalmic Registered Nurses (ASORN) (American Academy of Ophthalmology, 2022). The volunteer RNs then watched four one-hour long modules, on their own time, on Ocular Anatomy and Physiology, Ophthalmic Nursing Assessment, and the Ocular Manifestations of Systemic Diseases. Following the observation of the learning modules, the RNs were then given a post-learning assessment of ophthalmic knowledge, ophthalmic conditions, and ophthalmic nursing assessment.

Study of the Intervention

Initially, the quality improvement project was going to focus on teaching nurses the skills that are necessary to work in ophthalmology, like the use of a slit lamp microscope and the techniques necessary to check intraocular pressure. As there are, presently, restrictions on the actions that a nurse can perform in the ophthalmic setting, learning needed to be tailored to tasks that did not require teaching skills that nurses would not be able to perform per legislated scope of practice guidelines. A different approach was formulated with an emphasis on the foundational knowledge for the psychomotor skills acquisition.

Starting on May 23rd, 2022, nurses could begin to volunteer for the QI project and can express interest via email. Participation was voluntary, but an offer of compensation for

participation of 50$ per participant for completion of each project step was available. From there, each nurse was given the pre-test assessment virtually. Following the pretest each nurse was given access to the training modules developed for this quality improvement to complete on their own time, with the hope that they complete them at least weekly. The post-intervention assessment was given at the end of June 2022, and a Plan, Study, Do, Act (PDSA) assessment was completed to determine what changes, if any are needed through July 2022. Another module was to be created that addresses ophthalmic skills but will not be provided unless the BON approves of RNs being able to utilize instruments to check intraocular pressure and the use of a slit lamp. This final skills assessment can be evaluated in a later PDSA.

Measures

While appointments can be measured by the number of new referrals that a provider would be able to see, measuring the effectiveness of a training program is something entirely different. A search did not reveal a premade instrument previously designed or tested to evaluate nursing knowledge in ophthalmology. A project specific instrument to evaluate volunteer knowledge of ophthalmology before and after an intervention, therefore, had to be developed.

Volunteers took a pre-intervention test of their ophthalmic knowledge. This *pre-test* was be made up of 50, multiple choice, questions, randomly chosen from a 125-question quiz bank. The questions were derived from the previously mentioned *The Essentials of Ophthalmic Nursing* by ASORN. Volunteers were given a grade out of a 100-point scale, making each question worth two points.

Following the completion of the training modules, participants took a post-intervention test. This *post-test* was comprised of another, randomly generated 50 questions from the 125-

question quiz bank. This was also graded on a 100-point scale, with each question worth two points.

While both tests have not been independently verified and studied for soundness. They were developed from resources provided by the nationally recognized organization for ophthalmic nursing, ASORN, and represent the content areas that are highlighted in their study materials.

Upon completion of the tests the scores were compared, and the difference was calculated. From this we derived the mean scores of the *pre-test, post-test,* and the score change. From that a paired t-test could be calculated to determine if the change was statistically significant (p<0.05).

A secondary instrument has also been developed to assess the secondary aims of this quality improvement project. This will address volunteer perception of the learning environment, engagement in the coursework, and their thoughts on areas of strength and weaknesses.

Analysis

The most appropriate analysis that can be done is a measure of change scores over time during the training. By establishing baseline testing and final testing a determination if change (learning) is occurring over that time, answering the question if an ophthalmic nurse can be trained to assess patients in the ophthalmic setting within four weeks. Quantitative inferential statistical analysis utilizing a paired-t test was used to determine the overall effect of the intervention on participant knowledge and to determine if it is statistically significant.

Descriptive statistical analysis of the post-intervention survey will be done by evaluating volunteer choices on a five-point Likert Scale (Strongly Disagree, Disagree, Neutral, Agree,

Strongly Agree). After evaluation of survey responses, information can be synthesized and analyzed for recurrent themes that may further direct future PDSA cycles in this project.

Ethical Considerations

There are a few considerations in developing an ethical framework for this project. Patient privacy is not of particular concern, as patient records are not actively being accessed, and direct patient data is not going to be used in the data analysis. Participant privacy is an area of concern. Participant demographic information and employment information is not relevant to the quality improvement project and not a determining factor in the analysis; it will be omitted. The only information that will be included will be the overall length of time that the participant has worked as a registered nurse. Participants will also need to agree to partake in the training outlined, no formal agreement will be drafted, and participants can withdraw at any time, for any reason. Volunteers will be rewarded with a $50 gift card upon completion all QI areas (pre-test, training modules, post-test). Funding will be provided for this project will be provided by the author.

Bias is a concern as well. Nurses that have considerable experience in ophthalmic settings (> three months in an ophthalmic specific setting) will be excluded from the quality improvement project. These participants may have a higher baseline knowledge of ophthalmology and some advanced training, resulting in skewed results. Advanced Practice Nurses will be excluded from the project given their expanded education. All efforts will be made to ensure that nurses are naïve to ophthalmology to ensure accuracy in scoring.

Finally, this project will be evaluated by the University of New Hampshire Department of Nursing Quality Review Committee to ensure that it meets the definition of a quality improvement project and meets their ethical requirements, making it exempt from IRB reviewal.

Results

At the outset of this quality improvement project the major, overarching, question to be answered, was why are there so few nurses in the ophthalmic clinical setting? In looking at the scope of nursing education, it became clear that there is a knowledge gap for nurses when considering ophthalmology.

Fifteen volunteers agreed to take part in this quality improvement project, all of them registered nurses with no clinical experience in ophthalmology. Each nurse agreed to complete a pre-test assessment of their ophthalmic knowledge, to review four videos covering three topics important to the fundamental understanding of ophthalmology, to complete a post-test assessment of their learning, and to complete a final survey. Eleven volunteers (n=11) completed each step of the process, their data will be used for the analysis of the project. Initially there were only three videos planned, but the topic of ophthalmic manifestations of systemic diseases became so long that it needed to be broken into two videos.

Pre-Test

The eleven volunteers that completed the pre-test did so through an online portal that collected data about the participants age, years of experience in nursing and years of experience in ophthalmology. The average age of the participants was 36 years old. The average number of years' experience as a registered nurse was 8.72. None of the participants had any outpatient ophthalmology experience; one nurse had prior experience being floated to an ophthalmology

specific emergency department on three occasions. After speaking to this nurse, based on her

self-assessment of minimal knowledge about ophthalmology that nurse was included as a

participant in the quality improvement project.

The pretest is a multiple choice, 50 question test covering three subject areas: anatomy

and physiology of the eye, ophthalmic assessment techniques and ophthalmic manifestations of

systemic diseases. Table 1 shows the raw score totals for the 11 volunteers. Figure 1 is a graphic

representation of that data.

Table 1
Pre-Test Assessment Scores

	Pre-Test
Volunteer 1	46/100
Volunteer 2	48/100
Volunteer 3	46/100
Volunteer 4	34/100
Volunteer 5	40/100
Volunteer 6	30/100
Volunteer 7	40/100
Volunteer 8	50/100
Volunteer 9	38/100
Volunteer 10	42/100
Volunteer 11	54/100

Figure 1
Scatter Plot of Pre-Test Scores

Figure 1   Pre-test Scores
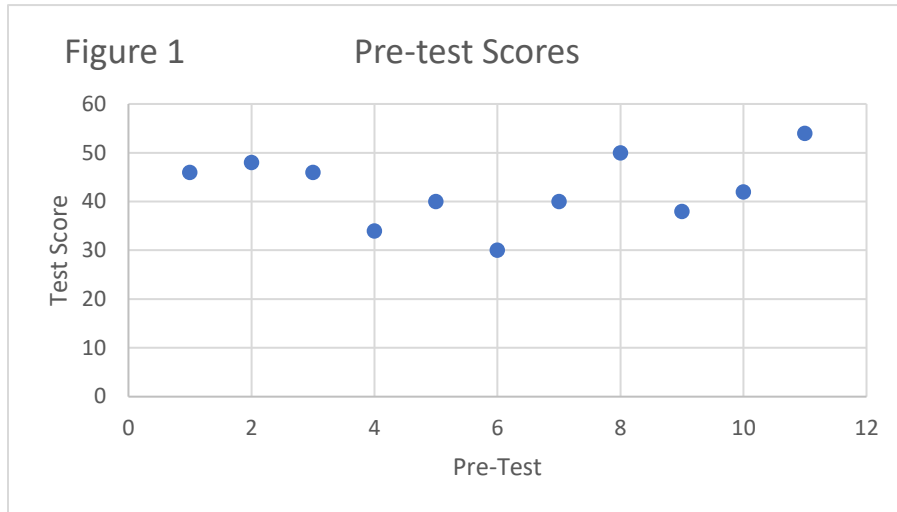
Table 2
Descriptive Statistics for Pre-Test Scores

Table 2 Pre-test	
Mean	42.54545455
Standard Error	2.142062033
Median	42
Mode	46
Standard Deviation	7.10441604
Sample Variance	50.47272727
Kurtosis	-0.418102744
Skewness	-0.192138751
Range	24
Minimum	30
Maximum	54
Sum	468
Count	11
Largest (1)	54
Smallest (1)	30
Confidence Level (95.0%)	4.772811638

The range of scores for the pre-test was a low of 30 and a high of 54, with a mean score of 42.54 (*SD*=7.1, Range=0-100) over the 11 participants. At the outset of this project there was not an expectation that nurses without prior experience in ophthalmology would score well on the pre-test.

Intervention

Via the website created for the quality improvement, www.eyenurses.com, each of the volunteers had access to four videos that covered the topics on the exam. They were given four weeks to complete watching the videos and then to complete the post-test. Volunteers also had access to the slides that were created for the project itself via the same website if they wanted to review it.

The videos were constructed using *Microsoft PowerPoint* ™ with information derived from textbooks created by the American Society of Ophthalmic Registered Nurses (American Academy of Ophthalmology, 2022). Using these textbooks ensured that the information being presented was aimed at nurses, focused on ophthalmology and had been peer reviewed.

Post-Test

Following each participant reviewing the study materials, they were invited to take a post-test, of 50 multiple choice questions, again focused on anatomy and physiology of the eye, ophthalmic assessment techniques and ophthalmic manifestations of systemic diseases. Table 3 shows the raw data of the post-intervention test and Figure 3 is a graphic representation of that data.

Table 3
Post-Intervention Test Scores

	Post-Intervention Test Scores
Volunteer 1	66/100
Volunteer 2	84/100
Volunteer 3	70/100
Volunteer 4	72/100
Volunteer 5	48/100
Volunteer 6	82/100
Volunteer 7	88/100
Volunteer 8	80/100
Volunteer 9	82/100
Volunteer 10	90/100
Volunteer 11	94/100

Figure 3
Scatter Plot of Post-Intervention Test Scores

Post-Intervention Test Scores
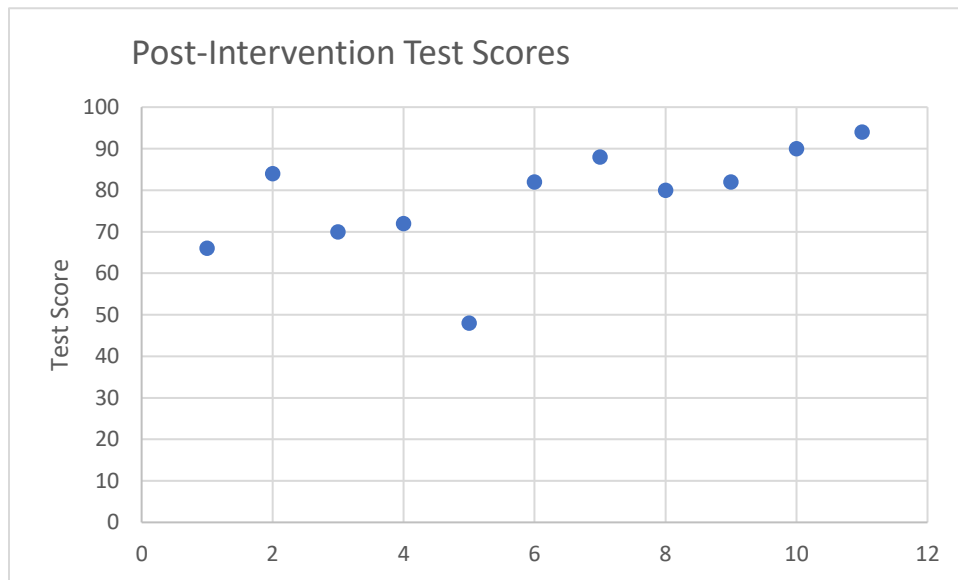
Table 4
Descriptive Statistics for Post-Intervention Test Scores

Post-Intervention Test Scores	
Mean	77.81818182
Standard Error	3.949265022
Median	82
Mode	82
Standard Deviation	13.09823028
Sample Variance	171.5636364
Kurtosis	1.553441424
Skewness	-1.160889316
Range	46
Minimum	48
Maximum	94
Sum	856
Count	11
Largest (1)	94
Smallest (1)	48
Confidence Level (95.0%)	8.799510833

The post-test results showed the mean score across the 11 participants was 77.81. The

participant's range of scores was a low of 48 and a high of 94 (*SD*= 13.1, Range = 0-100).

Inferential analysis was conducted via a paired T-test to evaluate whether the change in

scores between the pre-test and the post-test could have occurred because of chance, with the

null hypothesis set at zero. The data from the paired T-test is found in Table 5.

Table 5
t-Test: Paired Two Sample for Means

t-Test: Paired Two Sample for Means	Pre-test	Post-test
Mean	42.54545455	77.81818182
Variance	50.47272727	171.5636364
Observations	11	11
Pearson Correlation	0.203202779	
Hypothesized Mean Difference	0	
df	10	
t Stat	-8.619243246	
P(T<=t) one-tail	3.05E-06	
t Critical one-tail	1.812461123	
P(T<=t) two-tail	6.0932E-06	
t Critical two-tail	2.228138852	

There was significant improvement in the overall scores during the post-intervention evaluation, as evidenced by the statistically significant one and two tailed P scores below the 0.05 threshold. Participants all improved their scores after watching the learning modules. While there was some variation in the amount of improvement, with the lowest improvement being a score change of +8, the average improvement for the group was a score change of +35 points to their overall score.

The hypothesized mean difference between the pre-test and post-test was set to null. To determine if the intervention was statistically significant or if it occurred by chance. Critically to the evaluation of the quality improvement project the P-value is significantly less than zero ($P>0.05$). The one-tailed P Value for this QI project is 3.05E-06 and the two tail P Value is 6.0932E-06. Both values are significantly less than 0.05, making the findings within this quality improvement project statistically significant.

Post Improvement Survey

Each volunteer was asked to complete a survey following completion of the quality

improvement project. The survey was designed to gauge participant reactions about the project.

This survey had ten questions about the learner's experience with seven questions utilizing a five

variable Likert scale and four questions left open for response.

Table 6
Post-Intervention Assessment Survey Questions

Q1 - I feel more confident about my knowledge of ophthalmology after reviewing these three modules.
Q2 - I found the material to be presented at an appropriate level for someone with minimal experience in ophthalmology.
Q3 - I felt the material was presented in a format that was easy to access.
Q4 - I would be interested in learning more about ophthalmology after completing these modules.
Q5 - I believe a field like ophthalmology could benefit from nursing positions.
Q6 - Overall how engaging would you say the content is?
Q7 - How would you rate your overall learning experience?

Participant Experience. Volunteer learning experience was evaluated as planned with a

post-intervention survey based on the principles outlines in the Kirkpatrick Model.

For question one in Table 6 there was complete agreement that the participants felt

confidence in their knowledge about ophthalmology after completing the learning modules. With

100% of respondents noting that they agreed to some degree with the statement. 27% of

respondents strongly agreed that they were more confident in their knowledge.

Question two had greater variation in the volunteers when asked about the

appropriateness of the material for a new learner. One participant (9%) selected that they

somewhat disagreed with the level of the material. One participant remained neutral,

representing 9%. 54%, most respondents *somewhat agreed* that the material was presented at an appropriate level and 27% *strongly agreed*.

Question three, regarding ease of access to information for the quality improvement project, showed absolute agreement among participants. 100% found the materials easy to access.

There was moderate variation in how volunteers responded to question four. Most participants, 63% *somewhat agreed* that they would be more interested in learning more about ophthalmology. Another 18% *strongly agreed* that they would be interested in learning more about ophthalmology. One volunteer, 9% of respondents *somewhat disagreed* and another volunteer, 9%, remained neutral in their desire to learn more about ophthalmology.

Question five, which addressed current RN's opinion if ophthalmology may benefit from nursing positions was overwhelmingly positive. 45% of respondents found nursing in ophthalmology to be *somewhat appropriate*; 55% of respondents found that nursing positions within ophthalmology to be *extremely appropriate*.

Question six, addressing content engagement, showed great variation in volunteer perception of the material presented. One volunteer, 9% of respondents, found the material to be of poor engagement. Another three respondents, 27%, found the material to be of average engagement. Five respondents, 45%, found the material to have good engagement and two respondents, 18%, found the material to have excellent engagement.

Question seven identified how the volunteers found their learning experience during the quality improvement project. Two volunteers, 18% of respondents rated their experience as poor. One volunteer, 9% of respondents, found the experience average. Five respondents, 45% of

volunteers, found their experience to be good and the remaining 27%, or three volunteers, rated

the experience as excellent.

Free Response Questions. Open ended questions were created in domains that required

more input from volunteers. The responses were evaluated to determine if there were any

recurrent themes that volunteers reported, elucidating areas of improvement for future PDSA

cycles. One volunteer did not complete the free response questions, so data and percentages will

represent one less answer (n=10).

Table 7
Volunteer Responses to Request for Something Helpful in the Content Delivery

Volunteer Responses:
The thought used to put the videos together. Starting with A&P was very good.
Understanding the different parts of the eye was helpful in visualizing the disease processes
Videos covered the topics that we were quizzed on. Not much diverging from important information
Having all the steps on the website was very helpful and made things easy to access
Communication! Emails really helped.
Everything was very easy to access
Excellent speech tone and speed, great pronunciation
Website organization was helpful
Images, pictures of what to look for in patients
The 3rd and 4th modules that explain eye diseases

Question eight asked volunteers to identify something that they found helpful about the

QI project. A few themes emerged among what the respondents found helpful within the QI

project. Three people, 30%, found the website a helpful feature in this project, noting that

everything was easy to access. Another five respondents, 50%, found the videos/modules

helpful. Ease of use and content were the most robust themes within this section. One respondent

did mention communication as an area of strength, and another mentioned the quality of

speaking during the videos.

Table 8
Volunteer Responses to Request for Suggested Improvements

Volunteer Responses:
Making the content a bit more engaging. Sometimes it was difficult to pay attention.
Videos are too long; you could probably make a bunch of videos and make it better
The videos were so long
Felt like the narrator was reading from a book, later videos are more engaged
Videos were too long
Definitely can improve the length of the videos, just way too long, too much information at once. Maybe break them into smaller chunks?
Way too much detail
Engagement of the videos, they seem rushed
The length of the presentations was too long
Questions on test to focus on disease process

Question nine asked the volunteers to evaluate something that they believed could have been improved upon during the quality improvement project. When asking the volunteers what can be improved within the quality improvement project. A major theme developed. Nine out of ten responses, 90%, focused on the content and the length of the videos for the different learning modules. There were several suggestions to make the videos shorter to allow for better engagement. This is an interesting in comparison to question eight where five respondents mentioned that videos/modules were helpful. Several respondents found that too much information was presented at once, which may have resulted in the two responses suggesting that volunteers had a poor learning experience.

Table 9
Volunteer Responses to Request for Difficult Concept Identification

Volunteer Responses
The role of the nurse in some disease processes?
The different diseases could be better understood of we had more pictures or hands-on skills
It could help to actually spend time in clinic
I'd like to see actual patients
The concepts were pretty straightforward, I'd love to learn more about how the images are obtained
I think hands on experiences and seeing these patients in a clinical setting would be helpful
There were just too many details
I feel that learning could be enhanced with in person experiences
No
No, but A&P tends to be an arduous endeavor

Question ten attempted to determine if there were any concepts that the volunteers found difficult to learn in the format that the QI was presented, self-directed e-learning. Six of the respondents, 60%, suggested that in-person experiences in clinic would have helped their learning experience. Two respondents, 20%, noted that there were not any areas that they found to be difficult to understand, although one of them did mention anatomy and physiology as an *arduous endeavor*. One volunteer wanted to know more about the nurse's role in the disease process and one nurse chose to mention that there was too much information, again.

Question eleven was a final attempt to determine if respondents had anything else that they would like to add before completing their portions of the QI project. Only five respondents of the ten that filled out the free response questions, provided feedback to this question.

Table 10
Volunteer Responses to Request for Additional Comments

Volunteer Responses
Lots of information, try making smaller videos
I felt like there was so much content and a lot of it was more relevant to the physician's role
Definitely an interesting subject to learn about, I am surprised we didn't cover more of this in nursing school
The website was very nice easy to use and helpful
Less focus on eye A&P (on the test) and more how we can focus on disease presentation and the complications associated with them.

Some repeated themes came back at the last free response question. There was emphasis on the videos, their length, and how burdensome several volunteers found that. One respondent felt that the information was geared more towards the physician's role in patient care. This was a particularly interesting response because the modules were designed from materials that were created by the American Society of Ophthalmic Registered Nurses. Another nurse mentioned that they were surprised they had not learned more about this in school, underscoring the brief coverage of ophthalmic nursing during formal nursing education.

Project Observations

Perhaps the greatest challenge to the entire quality improvement project was having volunteers that were entirely self-directed. Volunteers were spread throughout numerous hospital departments. While fifteen people initially expressed interest in participation, only eleven completed each element of the project. Numerous emails were sent out to volunteers as reminders that each element of the project needed to be completed by 11:59 PM on June 30th, 2022, to receive compensation.

To facilitate and make it easy for volunteers to have access to all the required materials to work on this quality improvement project a website was created, www.eyenurses.com. The

domain was purchased from *Google Domains ™* for $10.00 for 365 days. A test making service

was also purchased at a cost of $20.00 a month. Videos were created with *Microsoft PowerPoint*

™ and uploaded to *YouTube ™* which hosts the videos free of charge.

Missing Data

Only data from volunteers that fully completed each step of the quality improvement

project were included in the results for the quality improvement project. There is no missing data

for this project.

Discussion

Summary

The specific aim of this quality improvement project was to see if, given educational

materials, registered nurses with no clinical ophthalmology experience would be able to increase

their working of ophthalmology on a post-intervention assessment to a score of 80% in four

weeks. This project also sought to evaluate the learning experience of the volunteers that agreed

to participate in the quality improvement project. Participants were allowed to perform each step

of the quality improvement interventions at their own pace over the course of four weeks via a

website portal that was accessible to each participant.

As to the specific aim, of the eleven participants that completed each step of the quality

improvement project, all of them improved their baseline score from the pre-test after completing

the learning modules. Seven of the participants increased their baseline score to the minimum

score necessary to be considered passing for the project. The mean aggregate pre-test score was

42.5 on a 100-point scale and the mean aggregate post-test score was 77.8 on a 100-point scale.

The specific aim of this QI project was to improve baseline scores among volunteers to a score of 80% out of 100. The specific aim was not met overall for this QI project, falling 2.2 percentage points short of that goal. However, seven of the eleven participants (63%) did improve their baseline scores to the metric set by the specific aim, representing a plurality of the volunteers. The mean score increase was 35 points of improvement on the 100-point scale, a clear, statistically significant ($p<0.05$), demonstration that ophthalmic clinical knowledge can be attained through learning modules designed for nurses. This demonstrated improvement in nursing knowledge can expand the pool of potential employees for ophthalmology. In so doing, it has the potential to increase the ability of an ophthalmic section to expand patient access to the retina service.

Learner Experiences

Several themes became increasingly clear through the post-intervention survey. Two of the themes have long-term structural implications for the future of this project. Firstly, many participants found the learning materials to be less than engaging, with three participants rating their learning as poor. This begs the question, if the learning materials were more engaging would the post-test mean increase even more? This is also a clear indication that learning materials need to be reevaluated and assessed by someone familiar with curriculum development to ensure that engagement and quality instruction are provided. Secondly, most participants felt that a *hands-on* experience would have increased their learning. It is well established that learning can be done effectively and efficiently in an e-learning environment (Chang et al., 2014; Fransen et al., 2018; Lahti et al., 2014; McDonald et al., 2018). There is literature that suggests a blended model of learning, where participants have instruction of some form, then a kinesthetic experience, provides a higher degree of satisfaction in learning and information retention (Du et

al., 2022; C. Li et al., 2019; Z. Li et al., 2014; Sáiz-Manzanares et al., 2020). Again, begging the question, if a kinesthetic experience were to be provided would educational satisfaction scores increase for this project? Most participants reported that the ease of access to the materials was greatly beneficial to their learning. This suggests that the use of a *one-stop*, easily navigable site for material distribution is a possible model for content delivery.

Lastly and perhaps, most importantly, the final theme that emerged was the agreement among the registered nurses who participated in the QI project, that ophthalmology is a very appropriate field for nurses to participate in. As ophthalmology, at present, depends largely on unlicensed medical assistants to provide large portions of patient triage and assessment, nurses can provide an expanded scope of practice and an increase in avenues for potential patient access.

Interpretation

Interpretation of the data would show that providing an educational intervention to a group of volunteers returns an overall improvement in baseline testing scores. It is not shocking to discover that teaching motivated volunteers a particular subject will result in an improvement, even to the slightest degree, in a post-intervention assessment. Education is an established practice formally or informally in every culture and throughout the animal kingdom.

While a literature review did not reveal any high-quality information about the breadth of ophthalmology education provided in nursing school. In a survey by Rattanasirivilai and Shirodkar (2021) of ophthalmic nurses in the United Kingdom, it was noted that 63% of respondents found that formal education on ophthalmic nursing was limited. In examining the undergraduate and graduate nursing curriculum at the University of New Hampshire, no courses

were offered that specifically focused on ophthalmology as a nursing field. This lack of

ophthalmology specific education makes the overall pre-test scores of the nurse volunteers,

unsurprising, with a mean score of 43 out of 100. Suggesting that, at baseline, ophthalmology is

a subject that nurses have little formal exposure to, even though ophthalmic complaints are

frequent chief complaints, estimates of 5-19% visits, in the emergency and primary care fields of

medicine (Succar et al., 2016). Of interest, experience in nursing did not equate to a higher score

on the pre-test. Nursing environment may have had a small impact on overall score, with nurses

from medical-surgical environments scoring higher than the average overall test score. Given the

projected need for greater ophthalmic services, worldwide, in the coming years, this raises the

idea that greater emphasis may need to be placed on ophthalmic education in nursing

curriculums.

Post-test scores showed consistent improvement in ophthalmic knowledge. Increased test

scores following educational interventions is not necessarily groundbreaking, but the post-

intervention survey did reveal that all 11 respondents felt, at a minimum, increased confidence in

their knowledge of ophthalmology. Ten volunteers, following the educational intervention,

expressed desire to learn more about ophthalmology, suggesting that the topic is of interest to

nurses and supports greater development of programs to engage and educate nurses about the

field. Chadha and Gooding (2020) provide tips for expanding ophthalmic education in the

undergraduate curriculum that can be incorporated into graduate and post-graduate opportunities

for nurses as well. Their tips include using e-learning as a format to engage more students and

providing opportunities in areas like free clinics for students to gain kinesthetic opportunities

(Chadha and Gooding, 2020). In clinic and kinesthetic experience was a theme that emerged in

the post-intervention survey, again demonstrating increased desire for exposure and interest in

ophthalmology. Anecdotally, during the creation of this quality improvement project, numerous registered nurses found it surprising that there was an American Society of Ophthalmic Registered Nurses (ASORN). Tangentially this suggests that outreach may also be necessary to encourage participation in and development of an ophthalmic nursing curriculum. With the approval for registered nurses use of slit lamp microscopes and tonometry by the New Hampshire Board of Nursing, opportunities can exist for the development of kinesthetic experiences for registered nurses.

Development of a curriculum is an area of concern. Numerous volunteers reported that their learning experience was poor or average (36%) and listed the engagement of the content as poor or average (45%). Regarding an area to improve upon, volunteers noted that the videos provided as learning modules could benefit from being shorter (81%). The development of the learning modules was derived largely from texts provided by ASORN, which in turn led to the development of the pre and post intervention assessments. Time truly became crucial to the development of learning modules, with no premade modules available for access and distribution, a *path of least resistance* development method was used. Chadha and Gooding (2020) note that there are many methods to engage learners with an interest in ophthalmology, including addressing needs based on national examinations, but also by incorporating reinforcement through social media, in-person experiences, and e-learning. Despite the content being largely viewed as unrefined, it is worth noting that volunteers experienced a mean score increase of 35 points from the pre to the post-intervention test, with the average post-intervention assessment score of 78 out of 100.

Opportunity Costs

This quality improvement project shows a significant opportunity cost if ophthalmology in nursing education continues to be neglected and other areas of specialty care that show increased difficulty for patient access. Nurses offer a viable alternative to increase patient access to care. With a four-week intervention nursing knowledge can easily be expanded in the ophthalmic field and with higher-quality content and hands-on experiences engagement may be higher and scores may improve more significantly. Patient access to tertiary fields like ophthalmology, especially in rural areas where care is impeded by transportation, distance and lack of providers, leads to unmet healthcare needs, lack of preventative screenings and untreated illnesses (Rural Health Information Hub, 2021). Institutional prioritization of patient access has the potential to improve health of rural residents, thereby improving the health of communities that rural health institutions support. Expecting patients to find care elsewhere, necessitating hours of travel, should not be the viable alternative to providing care in the communities that rural health systems operate. Disregarding nurse education as an alternative method to provide care to patients is potentially neglectful and should be evaluated further as a means of expanding access to critical areas of care.

Limitations

This quality improvement project would have benefited from greater direct oversight of participants. Having volunteers complete an intervention through asynchronous virtual learning, where materials are accessed at a self-directed unsupervised pace challenged traditional synchronous learning. This face-to-face method, traditionally delivered in a classroom, brick and mortar or virtual, allows for greater oversight of the learning experience. While the website

provided an ease of use for volunteers, allowing them to access pre and post-tests and lectures at their own pace. The website also allowed people to wait until the final week of the quality improvement process to start completing the required parts of this project. Greater direct oversight of the participants may have yielded more consistent completion of exercises. Direct oversight may have encouraged the four remaining volunteers to complete the project out of the fifteen that agreed to participate. To limit the lack of oversight, emails were directed to the volunteers biweekly on Monday morning and Friday morning. Efforts were also made to be available via multiple avenues to facilitate volunteer questions or concerns were also made. Ideally, in the future, this quality improvement project will have a more structured nature, with ability to oversee volunteers/participants.

It was challenging to find volunteers for the quality improvement project. Initially only four people agreed to complete the required steps of the process, which necessitated emailing, enmasse, entire departments to see if there were any volunteers that might be interested. This emailing did entice eleven more volunteers to complete the steps of the process. This may have also been limited by the amount of time given to find participants for this quality improvement project. As the section of ophthalmology does not have any nurses already working, there was not a pool of volunteers easily accessible. However, given the need to find avenues of increasing patient access, in the future actual job postings may create a built-in pool of participants interested in the field of ophthalmology and nursing.

Time, the fickle indifferent element that, try as we might, we cannot escape from, was perhaps the greatest limitation to this entire quality improvement project. Four weeks to find qualified volunteers; to create three modules that covered three core topics important to ophthalmic nursing; provide them direction, answer questions and have them complete each

element of the intervention. An additional four weeks then to gather all the completed data and synthesize the information. Time became a shockingly small window to gather the requisite elements. More time at any one of these junctures but particularly in the content creation for the improvement, as the quality of the content became a theme in the post-intervention survey, may have created a better environment for the volunteers to learn and improved outcomes. Ultimately the time limitation for content creation allowed for the most straightforward manner possible which, admittedly, did not create engaging content. With feedback from the volunteers, refining and developing updated content will become a priority. Better engagement may increase volunteer completion of the course work and provide better interest for volunteers in the future.

Bureaucracy became another issue that limited the scope of this improvement project significantly. As it would be unethical to teach skills that nurses would not be otherwise permitted to use in a clinical setting with the current scope of practice limitations in the state of New Hampshire, a different learning method other than kinesthetic learning had to be developed. Another resounding theme from the post-intervention survey was the desire of actual clinical experience from many of the volunteers. At the start of the project the Board of Nursing had not yet decided if a registered nurse would be permitted to use a slit lamp microscope or to check a patient's intraocular pressure, both of which are integral to the ophthalmic patient assessment. With advocacy, the BON reviewed and approved a scope of practice challenge to allow RNs, with appropriate training and oversight, the use of a slit lamp microscope and measurement of intraocular pressure. While approval from the BON is a desirable thing, it does not provide carte blanche to begin the practice and/or teach these skills in the clinical setting, macrosystem reviews are still necessary. Once a macrosystem review is completed and with proper training

and oversight opportunities for kinesthetic learning are possible and should be considered when undergoing a quality improvement project of this nature.

Surprisingly, interdepartmental support was not a limitation. As the global aim of this quality improvement project is the ability to expand patient access to care, institutional support has also been strong throughout the quality improvement process. Bias did come into question in terms of requesting scope of practice changes from the board of nursing, particularly with members within the section of ophthalmology concerned with *scope of practice creep*. *Scope Creep*, a term that was originally used in project management to describe a project that has additional features, functions or requirements that were not originally agreed upon at the outset of the project, sometimes these additions are unauthorized (Roy & Searle, 2020). In healthcare, *scope creep* refers to procedures and practices that, typically, fall within a doctor's or other healthcare professional's scope of practice, but sometimes after evaluation are accessible to other professionals. Efforts were made to educate and engage in discussions with the individuals that were concerned, with some discussions reaching breakthrough points where concerns were ultimately related to emotional responses as opposed to fact-based or logic driven responses.

Conclusion

Several key implications became apparent because of this quality improvement project. First, and perhaps more important, more must be done to educate nurses about ophthalmology at whatever level is most feasible. Whether it be an elective course offered during undergraduate studies, a course provided upon graduation at facilities that serve patients with ocular conditions, or a microsystem specific course used to orient new employees to an unfamiliar subspecialty. Previously it was mentioned that minimal research was found during a literature search for ophthalmology specific nursing education, this alone should spur future research and encourage

nursing departments in academic institutions and hospital systems to develop programs to appropriately serve this population of patients.

Second, future PDSA cycles should be developed that address the strong themes that resulted from this quality improvement project. Development of content in conjunction with the expertise of instructional design support and educators could bring about a learning experience that students find is more engaging. In clinic, kinesthetic experiences should also occur. With the New Hampshire Board of Nursing approving registered nurse use of slit lamp microscopes and measurement of intraocular pressure, there now exist opportunities for nurses to assess patients in ophthalmic clinics where appropriate oversight can be guaranteed. This will also allow nurses to interact with patients who are experiencing some of the conditions they are learning about. This may also provide opportunities to instruct nursing personnel in other departments, like the emergency department, in these assessments to better serve the community of patients they see.

Third, self-directed learning can work to expand knowledge in a field in which a motivated learner works. John Donne, the sixteenth century poet, stated something to the effect that no person is an island (Donne, 1988). While desire to learn a subject is wonderful, we cannot expect people to do so alone, hoping for a care package that adequately explains the trabecular meshwork. For any program to work, for anyone to succeed, for access to be increased and communities changed, support is needed at so many distinct levels. Nursing program directors who will recognize the student that is interested in a niche field where nursing practice and tradition is obtuse or rarely performed are needed. So too are Board of Nursing members who are willing to sit and learn about requests, putting emotion aside to understand that patient access impacts so much more than budgetary matters, that delays in care in ophthalmology have tangible implications in quality of life of patients. Physicians that understand working with a

nurse and providing teaching does not mean scope of practice creep but means an avenue in which we can provide care to more people that are in desperate need of help. We are not islands; we cannot struggle alone in a sea of knowledge without help and direction of guidelights along the way.

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