Screening and Intervention for Glaucoma and eye Health through Telemedicine- SIGHT
Formal Title: Sustainable Community Clinic Telemedicine-Based Glaucoma Screening

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BACKGROUND AND SIGNIFICANCE

Glaucoma Epidemiology and Glaucoma Disparities. The prevalence of glaucoma in the United States (US) is expected to grow from the current 2.7 million to 4.2 million by 2030. Researchers estimate that 50% of people remain undiagnosed, so 2.1 million US citizens will remain undiagnosed in 2030 with current screening methods. Health care disparities exist with African Americans being three times more likely to have glaucoma, five times more likely to have unilateral blindness from glaucoma, and twice as likely to have bilateral blindness from glaucoma, compared to Caucasians. The National Academy of Science, Engineering & Medicine (NASEM) has recommended a call to action to make eye health a population health imperative. One target is to improve eye care for underserved populations that include African Americans and people with lower socio-economic status. There is a critical need to address disparities in population eye care and to minimize glaucoma-related vision loss.

Programs screening for glaucoma in impoverished communities have identified glaucoma and glaucoma suspect cases at much higher rates than within the general population. In Philadelphia, Pennsylvania, community-based comprehensive eye exams identified incident glaucoma in 17% of those screened and incident glaucoma suspects in 21% of those screened. Similarly, in Birmingham, Alabama, community-based comprehensive eye examinations identified incident glaucoma in 19% of those screened and incident glaucoma suspects in 23% of those screened. This demonstrates the scientific rigor of focusing glaucoma screening on populations at high risk of the disease as a critical first step to changing the prevalence of un-diagnosed glaucoma and subsequent glaucoma-related vision loss.

We hypothesize that implementing a telemedicine platform will decrease the glaucoma screening gap. Telemedicine can take specialty glaucoma services to the locally trusted environment of primary care community clinics. Telemedicine involves the electronic communication of medical information from one site to another for review by physicians specializing in the conditions being assessed.[16] Screening patients does not require an in-person specialist encounter, so evidence-based specialty care becomes accessible in geographically remote areas and does not require patient transportation over long distances. Therefore, telemedicine helps overcome logistical and psychosocial barriers to care. Patients are accustomed to finding transport to their community clinic, and social workers in these clinics can help patients access transportation resources to the clinic. Thus, a telemedicine approach can improve access to glaucoma screening, currently lacking for these communities.

OBJECTIVE

Our objective is to overcome a key set of critical barriers to glaucoma care by addressing the logistical and psychosocial issues that limit the access of vulnerable populations; by enhancing

and expanding our current partnerships with community clinics: Hope Clinic (Ypsilanti, MI), and a federally qualified health center Hamilton Community Health Network (Flint, MI), to enable local screening for glaucoma and other potentially blinding diseases among vulnerable populations using a telemedicine approach.

SPECIFIC AIM/HYPOTHESIS

Aim 1: (Phase 1- HUM 00173023) Use community-engaged research strategies to overcome key logistical and psychosocial barriers to accessing glaucoma care for uninsured and under-insured adults. To engage communities in glaucoma program development. we will create a Community Advisory Board (CAB) to solidify a trusting partnership between the University of Michigan, the Hope Clinic, Hamilton Community Health Network. We will conduct semi-structured interviews with patients and community stakeholders to understand barriers to eye care and inform program development and implementation.

Aim 2: **(Phase 2- HUM 00169371**) Develop a sustainable telemedicine model for glaucoma screening and care in community clinics. We hypothesize that a validated Veteran's Affairs (VA) telemedicine glaucoma screening program will identify a higher prevalence of glaucoma in primary care community clinics than screening the general population. We will test this hypothesis by implementing: (1) an automated technician-lead glaucoma screening with the VA protocol in the Hope and Hamilton partner community clinics for approximately 5,800 participants over 4 years; (2) remote ophthalmologists' grading of glaucoma screening tests for diagnosis and management; (3) a one-month follow-up visit with the technician to deliver low-cost eyeglasses and to educate and arrange ophthalmology care for participants who screen positive for eye disease; and (4) assess a 24-month change in vision and vision-related quality of life among participants screened during Year 1.

Aim 3: (Phase 2- HUM 00169371) Integrate personalized glaucoma education and counseling during the technician visit and test the behavioral intervention's impact on adherence to follow-up care with an ophthalmologist. We hypothesize that personalized eHealth education and motivational-interviewing-based counseling will improve adherence to glaucoma follow-up care compared to standard education delivered by a trained staff member. We will test our hypothesis in a randomized controlled trial with participants (n=400) from Aim 2 who have glaucoma or suspected glaucoma. We will make iterative refinements to our existing evidence-based, individualized counseling/eHealth glaucoma education program with a focus on adherence to follow-up recommendations based on learning in Aim 1. The primary outcome is the proportion of participants attending the recommended physician appointments within three months. Secondary outcomes include glaucoma knowledge, satisfaction with communication, and confidence in asking the ophthalmologist questions. Program economic efficiency will be assessed.

METHODS

Aim 1: Use community-engaged research strategies to overcome key logistical and psychosocial barriers to accessing glaucoma care for uninsured and under-insured adults

and develop and implement a telemedicine-based glaucoma screening program in the community clinics.

In Aim 1, we will use community-engaged research to understand community-specific barriers to glaucoma screening uptake and follow-up glaucoma care. We will use semi-structured interviews with key-stakeholders, including patients and providers, to understand how best to implement glaucoma screening and follow-up care in community clinics that are both located in cities with high rates of poverty. We will obtain informed consent and interview up to 50 people including patients with glaucoma, eye care providers, and community clinic staff.

Semi-structured interviews will explore: (1) community-specific barriers to eye care and follow-up, (2) how a telemedicine glaucoma screening program could be best implemented to meet people's needs, and (3) what educational components would be most salient in motivating people to return for glaucoma follow-up care.

We will form a Community Advisory Board (CAB) comprised of leaders from the Hope and Hamilton clinics, providers from the clinics, patients from the community and university researchers. The board will meet quarterly throughout the grant period to refine, implement, analyze, and discuss how to sustain the interventions. Following written informed consent, CAB members will be asked to take a brief survey at each meeting. A crosslink file containing survey participant names with a study identifier will be kept to correlate member responses over time.

Data Analysis

Qualitative methodology: We will use a semi-structured interview guide to inform the conversation. All interviews will be audio-recorded and transcribed verbatim. Transcripts will be investigated for major themes by two researchers using grounded theory, which uses inductive reasoning to analyze what participants said without coming to the interviews with a pre-conceived notion as to how the data should be categorized. Key ideas and phrases expressed by the participants will be categorized as codes. A code book is then generated as a team. Five transcripts will be coded, and inter-coder reliability will be calculated using qualitative software. The two coders will then code the transcripts and major themes will be identified. This information will inform program development and implementation.

Aim 2: Develop a sustainable telemedicine model for glaucoma screening and care in community clinics.

In Aim 2, we will deploy a telemedicine glaucoma screening program in the primary care-based community clinics. We will offer both free glaucoma screening and a free eyeglasses exam.

Telemedicine-based vision and glaucoma screening protocols developed and validated by the US Veterans Affairs (VA) Medical Center will be used.[1] Following the Technology-Based Eye Care Services (TECS) program, an ophthalmic technician is based permanently in a primary care clinic and will operate out of a room containing only essential ophthalmology equipment (i.e., no slit lamp). The technician will test the patient's vision using automated processes (e.g. autorefractor, hand-held tonometer, fundus photographs,

and optical coherence tomography). Data will be transmitted via a secure electronic health record (EHR) to a remote ophthalmologist. The ophthalmologist will review the data, develop an assessment and plan including prescribing eyeglasses and follow up for suspected eye diseases, if identified. We will use the secure image storage and reading platform at the UM Kellogg Eye Center, to transmit imaging data from community clinic sites to the University for images to be assessed.

Research Design

Recruitment:

Participant selection at Hope & Hamilton clinics

Inclusion criteria:

≥18 years of age

Exclusion criteria:

Significant eye pain (≥ 8 out of 10)*

Sudden decrease in vision (within 1 week)*

Double vision that doesn't stop when you blink and stops no matter what eye you cover (not blurred, but seeing 2 objects*

Pregnant women

Prisoners

Cognitive impairment- unable to give an ocular and social history

Moving outside of Michigan or driving distance to the clinic within 6 months

*if any of these symptoms are present, the patient will be directed to the primary care physician staffing the clinic

We will focus on recruiting people with diabetes and African Americans over the age of 50. We will recruit participants by calling people prior to their scheduled appointments at the primary care and dental care clinics. We will describe the study and let them know they can participate on the day of their scheduled appointment. Additionally, when the ophthalmic technicians' have availability, they will encourage referrals for diabetic patients seen in clinic that day. We will publicize the program in both free clinics using print media to open the program to self-referrals. To make the program more widely known in the community, we will have information about the program on the clinic websites.

Study staff will become registered clinic volunteers. This will allow them access to clinic space and electronic records.

Consenting non-English reading participants

For participants that are unable to read English, we will provide them a short form consent or full consent in the language they can read and ask them to sign. These participants will also be given a written summary/short form in English that has been signed by a study team member. A friend or family member (witness) that is fluent in both English and the participants language will be present and will translate the short form English consent for the participant. This witness will sign both the English and non- English forms and a copy of these signed forms will be given to the participant.

Consent form signatures

English summary or long form English consent- signed by a study team member & witness

Non-English short form or Non-English standard form consent- signed by participant & witness

Participant receives a signed copy of both forms. Study personnel retains all forms that were signed.

Consent forms available

Standard informed consents are available in English, Spanish, Albanian and Arabic

Short forms are available in Chinese, French, Hindi, Korean, Igbo and Tagalog

Baseline screening examination: Screening examinations will take approximately 1 hour. The technician will contact UM registration to create a unique UM Medical Record Number (MRN) for each patient, which will be linked to their community clinic MRN through a secure spreadsheet. Images will be stored using the UM MRN on the secure UM ophthalmic imaging platform. If the patient is not currently a clinic patient, creating a patient record at Hope is not necessary, although creating a patient account at Hamilton is required.

Ophthalmology Technician Eye Exam:

(1) Health history

(2) Vision exam for uncorrected and best- corrected visual acuity (UCVA and BCVA) at distance and near

(3) Contrast sensitivity

(4) Eyeglass evaluation including inter- pupillary distance

(5) Eye exam testing including pupillary response, anterior chamber angle assessment by penlight, extraocular motility and alignment, and intraocular pressure measurement

(6) Imaging of the posterior pole by fundus photography and Optical Coherence Tomography (OCT)

Technicians will have a "no dilation" protocol for patients with narrow angles by penlight or those with a history of glaucoma, an afferent pupillary defect, or intraocular pressure ≥ 21 mmHg. Previous community-based screening studies have had no cases of acute angle

closure glaucoma by following these recommendations. All other patients will be dilated prior to photography. Dilated participants will be instructed to return to the clinic if they should experience any headache, eye pain, redness or nausea after their examination. If a participant returns with any of these complaints, the technician will re-measure intraocular pressure. If IOP is elevated by >5mmHg over their pre-dilation measurement and >21mmHg, the technician will contact the ophthalmologist on call. Protocols exist for potentially urgent situations, including but not limited to: acute vision loss, flashes and floaters, severe eye pain, an afferent pupil defect, new onset double vision, or intraocular pressure measure ≥32 mmHg. The technicians will also be trained to contact the physician if they see abnormal findings on fundus photography, using the TECS training as a guide.

Upon dilation, fundus photographs and OCT images will be taken. The fundus photography protocol will be the validated protocol used for the VA diabetic tele-retinal screening program. Four photographs are taken: 1) an external photograph of the eye; 2) an image centered on the posterior pole; 3) an image centered on the optic nerve; and 4) an image centered on the supero-temporal arcade. Spectral-domain OCT will be used to obtain images of the retinal nerve fiber layer and ganglion cell layer of the macula. The UM software platform for storing and visualizing ophthalmic images will be utilized. The cameras will have software installed that facilitates all images being uploaded automatically to the imaging platform under the participant's UM MRN following HIPAA secure standards.

Baseline Surveys: For surveys, ophthalmic technicians will administer the National Eye Institute Visual Function Questionnaire – 9 to patients, which assesses vision-related quality of life. Additional surveys will include: Flint Water- questions are related to living in Flint during the water crisis, Everyday Discrimination Scale, Perceived Stress Scale, UCLA Loneliness Survey, Fall history and Timed Up & Go. They will also administer a standardized survey about socio-demographics and health history. Patients will confirm their address, phone number, and contacts in case of an emergency.

Eyeglasses: After the examination, ophthalmic technicians will help participants who need correction select free (ReSpectacle.org) or low-cost (ZenniOptical.com) eyeglass frames. ReSpectacle.org are donated glasses that have been categorized by exact prescription and are viewable on the website. The organization ships the glasses free- of charge. Participants may also purchase low cost ($10-$50) glasses on ZenniOptical.com. On this website, people can choose the frames. For both options, technicians will place the on-line order after the ophthalmologist confirms the eyeglasses prescription remotely, glasses will be shipped to the clinic.

Physician Evaluation: Physician's evaluation will be via a store-and-forward telemedicine technique. This store-and-forward technique, or asynchronous telemedicine, involves the electronic transmission of health data to the provider for evaluation and management. Physicians will review data received within 1 week. The reading ophthalmologist will enter the data into the UM EHR (MiChart). The physician will complete one of two letters with the examination results for the participant indicating whether the participant has ophthalmic disease or not. A time frame for an in-person ophthalmologist examination will be requested if needed. This letter will be sent to the patient via mail and the technician and the patient's PCP (if they have one) via the EHR.

Physician Review Glaucoma Screen: In terms of glaucoma screening, a "positive screen" for glaucoma or glaucoma suspect will include the following exam criteria as defined by the TECS protocol:
1) Cup to disc ratio ≥0.7
2) Intraocular pressure ≥ 21 mm Hg
3) Disc hemorrhage
4) Asymmetry of the cup-to-disc ratio by ≥0.2 where the larger cup-to-disc ratio is ≥0.6
5) Rim thinning or focal notch
6) Abnormal retinal nerve fiber layer observed on OCT defined as >10 microns difference in average retinal nerve fiber layer between the two eyes or the presence of thinning (defined as <5% or yellow) in any of the superior or inferior clock hours)
7) Narrow angles on penlight examination or any other concern for narrow angle (complaint of chronic headache or red eye)
9) Afferent pupillary defect
10) Patient already on treatment or being followed for glaucoma

Physicians will also evaluate for diabetic retinopathy and macular degeneration using validated TECS protocols. If the ophthalmologist identifies an urgent issue such as corneal ulcer, optic disc edema, melanoma, tumor, or retinal vascular event (e.g. central or branch retinal vein or retinal artery occlusion), the physician will contact the patient by phone to arrange immediate care.

Follow-up: The technician will schedule a follow-up visit 4-8 weeks later to give participants their eyeglasses and adjust them. Participants that do not need eyeglasses, but screen positive for eye disease, will return to review their diagnosis letter and management plan and help the patient to schedule an in-person appointment with the ophthalmologist. The ophthalmic technician will help the patient arrange follow-up care and provide educational material to explain diagnoses of cataract, diabetic retinopathy, macular degeneration or glaucoma. (UM Health System Patient Education Clearinghouse at https://pteducation.med.umich.edu/kellogg) If the participant has no need for eyeglasses and has no eye disease, the technician will call the participant to cancel the follow-up appointment after reviewing the ophthalmologist's recommendations. During the follow-up phone call, the satisfaction survey will be administered that would have otherwise been administered at the follow-up visit.

Glaucoma or glaucoma suspect: Patients with a diagnosis of glaucoma or glaucoma suspect who speak English will be randomized (1:1) to receive standard care as described above, or a 60-minute personalized counseling and education program (intervention) about their diagnosis and the importance of glaucoma follow-up care in maintaining vision (**Aim 3**)). Ocular hypertension that is low risk for developing glaucoma within one year and/or the recommended follow up time period is one year or more, will not be randomized, the PI will review these cases to determine if they should be randomized or not. Randomization will occur in web-based randomization system. Both groups will be provided support scheduling their ophthalmologist exam and will be asked to complete a brief satisfaction survey. The standard care group will receive a reminder call prior to the ophthalmologist exam, while the intervention will receive a

reminder call as well as a 10-15 minute motivational-interviewing based- counseling follow-up phone call to remind them of why following up for glaucoma care is important to them and trouble-shoot barriers to attending. Further discussion regarding personalized counseling and motivational interviewing can be found later in this protocol. All non-English speaking patients will not be randomized and will receive standard of care education; the personalized counseling is only available in English. We have created a Spanish version of the personalized counseling. Spanish speaking participants will not be randomized, all will receive the personalized coaching session. A Spanish speaking study coordinator will conduct the Spanish eHealth coaching. All subjects participating in the counseling/education encounters will have the option to have their sessions be audio-recorded. Additionally, we will ask English and Spanish speaking participants to complete a visual field test at this appointment. A visual field test measures peripheral vision and is used to review glaucoma patients. This test will take about 20 minutes and there will be no charge to the participant or their insurance. Visual field data will be entered into the REDCap database.

March 2024. Interviews have been completed; no further interviews will be conducted. Spanish speaking participants will be asked to participate in a post- coaching semi-structured interview to identify program components that are helpful/unhelpful and areas for improvement. Interviewers will follow the survey interview guide post-coaching interview guide and participants will receive a $20 Visa gift card. Additionally, interviews will be recorded, transcribed, and stored on a secure UM server. Qualitative software such as Dedoose may be utilized.

Planned Analysis Results Nov. 14, 2023

A planned analysis reported no difference in adherence between the intervention (personal coaching) and the control (standard education). Therefore, we will no longer randomize glaucoma/glaucoma suspect participants and instead ask them to choose which education they would like to receive.

Follow-up surveys: All returning participants will complete a satisfaction survey. The intervention group will also be asked to complete; 1) National Eye Institute Glaucoma Eye-Q test, 2) Satisfaction with Information Scale, 3) Clinician and Group Survey of the Consumer Assessment of Healthcare Providers and Systems (CG- CAHPS), 4) Health-Care Climate- eye care (HCCQ), 5) Confidence in question asking, which will be assessed with the following question "How confident are you in your ability to know what questions to ask the ophthalmologist?" and will have responses ranging from 1-10 on a Likert scale where 1 is "not confident at all" and 10 is "extremely confident."

Follow-up Care with an Ophthalmologist: The ophthalmologists who remotely reviews the screening examination data will make recommendations follow-up care. All patients who screen positive for ophthalmic disease will be referred to the comprehensive ophthalmologist at the Hamilton Clinic, or to the Hope-Kellogg ophthalmology clinic that runs every two months on a Saturday. The comprehensive ophthalmologists will either provide definitive care or provide a referral for further sub-specialty care. If the patient has barriers to accessing sub-specialty care at the Hamilton clinic, social workers and financial counselors will be involved to help with logistical barriers. If a patient from Hamilton clinic

has moderate or severe glaucoma, they can be referred to see the glaucoma specialist from UM who will have one day of clinic per month at Hamilton Clinic. If a patient from Hope requires further specialty consultation or surgery, they will sign up for MSupport, the UM charity care program, with the financial counselor available on-site during the Saturday clinics. Once a patient receives MSupport, they receive free care and medications at the UM for 12 months with the option to renew the services annually with proof of low income. Once a patient receives MSupport, they will be scheduled with the appropriate provider at the UM. For participants that are glaucoma/glaucoma suspect and seen at Hamilton or the Kellogg Eye Center for their follow up exam, these findings and visual field data will be collected and entered into the REDCap database.

One-Year Vision Outcomes: Repeat screenings at one year following the participants initial enrollment will take place during the second and third year of the program, where phone calls will be made to participants screened in the first or second year of the program (regardless if they screened positive or negative for disease) to encourage them to return for a second screening. When they return, they will follow the same protocol as described for the initial visits with the ophthalmic technician above. Although, One-Year visit survey data will only include demographics and the VFQ-9 and Falls survey which they also completed in their initial enrollment. Participants who were already randomized to the clinical trial in Aim 3 will not be re-randomized.

Two-Year Vision Outcomes: Repeat screenings will take place during the third year of the program, where phone calls will be made to all participants screened in the first year (regardless if they screened positive or negative for disease) to encourage them to return for a second screening. When they return, they will follow the same protocol as described for the initial visits with the ophthalmic technician above. Participants who were already randomized to the clinical trial in Aim 3 will not be re-randomized.

Participants that do not return to the clinic for a repeat screening examination, will be asked to complete the VFQ-9 survey over the phone when they are contacted.

One and Two-Year Vision Outcomes: <u>These participants will need to meet the inclusion/exclusion criteria listed in section Recruitment Section of this protocol.</u>

Post Program Participant Interview: We will ask up to 75 participants to participate in a post program interview to identify program components that are helpful/unhelpful and areas for improvement. We will randomly contact English speaking participants within our study database that agreed to be contacted for future studies. The study consent document contains an additional signature section for participants to consent/not consent contact for future research. Selected participants will be contacted by phone, or in-person following their last appointment. Interviewers will follow the survey interview guide. Interviews will be conducted via in-person at the clinics, telephone, or UM Zoom. Participants will receive a $20.00 Visa Gift Card or check by mail or in-person. Additionally, interviews will be recorded, transcribed, and stored on a secure UM server. Qualitative software such as Dedoose may be utilized. 1/24/2023 English post program interviews have been completed.

Evaluation of "No-show" Appointments: We will evaluate our high (approximately 35%) no-show and last-minute cancelations rates at this community clinic study (Hope & Hamilton

Community Clinic). The SIGHT study is open to non- clinic patients, therefore, potential participants may or may not be clinic patients. We will only review data of the SIGHT study "no shows" and will not include the clinics appointment "no shows". When potential participants contact the SIGHT team, the team member reviews the recruitment script that describes the study. Following this discussion and verification of study eligibility, a medical record number (MRN) in MiChart is created for those that do not already have an MRN. The SIGHT study baseline appointment is then made within the MiChart system. This process is completed prior to consent.

It may be possible that high no-show rates are associated with lack of convenient transportation. By accessing patient information for those that missed appointments, we can investigate the logistical barriers of cost and transportation for show versus no-show patients. Associations between outcome variable (shows versus no-shows) and demographics, including age, sex, and race, zip codes and logistical factors such as cost, travel time, and distance from appointment location will be studied graphically (e.g., boxplots and scatterplots) and with appropriate inference tools (e.g., t-tests, chi-square tests, regression) where available. This will be completed by utilizing the potential participants medical record number access the described variables where available. Additionally, when available, reasons given by the potential participant to the SIGHT team for "no-shows" and last-minute cancellations will be analyzed.

Healthcare Effectiveness Data & Information Set (HEDIS)

HEDIS scores are a standard system to measure patients' compliance to health care treatment/testing for a variety of conditions/diseases. A retinol eye examine is part of the diabetes HEDIS score, and this is included with our exam. We would like to review the diabetic HEDIS scores at Hamilton Clinic through their database to see if there have been changes following the implementation of the SIGHT program. This database is de-identified.

Recording of Data: The ophthalmic technicians will enter all data from each patient encounter into both the UM EHR. The research assistant will then enter the data from the EHR into a secure research database, REDCap. Data will be entered into the EHR as a no-charge research visit. The ophthalmologist's letter to the patient with the diagnosis and plan will be abstracted from the EHR by the Project Manager and the diagnosis and follow-up plan will be entered into REDCap. The Project Manager will also run weekly reports from the EHR to assess adherence to follow-up recommendations for study participants and enter this data into REDCap.

Visual Impairment

We will review participants with visual impairment of Best Corrected Visual Acuity (BCVA) less than 20/70 or legally blind BCVA 20/200 or worse in the better seeing eye and visual field results with less than 20 degrees in the better seeing eye. We will determine if there is any statistical significance between presence of visual impairment and demographic data. Additionally, we will determine the proportion that meet the requirements for Michigan Bureau of Services for Blind Persons for participants with progressive and non-progressive disease.

Pupillary Light Reflex Device Data Collection- Completed 10/2023

The pupillary light reflex (PLR) is a standard part of every eye examination used by eye care professionals to provide critical information about the health and integrity of the visual system. When light is directed at the pupil, stimulated photoreceptors in the retina transmit the signal through the optic nerve to the midbrain. The sensory signal is processed in the midbrain and the autonomic nervous system via the parasympathetic (pupil constriction) and sympathetic (pupil dilation) nerves, coordinating a motor response in both the stimulated and unstimulated eye. However, the typical PLR relies on subjective observation by examiners and the data collected is imprecise. Consequently, current PLR assessment suffers from poor reliability and reproducibility, affecting its utility across care settings over time.

To address these issues, we have developed an inexpensive, binocular, handheld PLR system that captures high resolution video imaging and determines pupil constriction dynamics with machine vision algorithms. The quantitative PLR system (Q-PLR) is a handheld binocular device requiring minimal operator effort and skill that uses machine vision algorithms to capture high resolution video images and information about pupil constriction dynamics. Using LED light sources and low-light infra-red cameras, the Q-PLR automatically tracks pupils, and captures static and dynamic pupillary parameters. Pupillary measurements are accurate to 0.5mm, or less, and sampled at 30 frames per second, which is an appropriate sampling frequency to assess pupillary changes. Unlike the pupillometers currently available for clinical use, both pupils are imaged, measured, and recorded simultaneously. Assessment of inter-pupillary responses provides additional information about the relative integrity of retinal and optic nerve function. While pre-clinical testing of the prototype system has been reproducible, further testing in real-world clinical settings must be performed to assess the robustness of the system. First, further testing in real-world clinical settings must be performed to assess the accuracy, reliability, and robustness of the system to environmental and operator variability when compared to standard pupil exams. Second, the system must demonstrate clinical usefulness for clinicians and paraprofessionals using the device. To accomplish these aims, we will collect clinical examination data captured as part of the standard eye examination from participants in the SIGHT program and compare to Q-PLR image capture. We will additionally obtain qualitative feedback from ophthalmic technicians to improve device usability. We will only ask English and Spanish speaking participants to take part with this measurement. Data collected from the Q-PLR will not be reviewed for participant assessment. There is no known risk, the device camera operates like a smart phone.

<u>Outcomes</u>

Primary: The primary outcomes will be the number of participants screened and the prevalence of glaucoma/glaucoma suspect diagnosis and the cost per case of detected disease.

Secondary: 1a) Prevalence of other eye disease: visual impairment (visual acuity in the better seeing eye <20/40) on screening presentation, refractive error, cataract, diabetic retinopathy, and age-related macular degeneration. Prevalence will be determined by dividing the number of cases of disease on initial screening exam by the total number of participants who received screening each year. 1b) Incident disease will be estimated by

assessing the number of new cases of eye disease among the participants screened in the first year who returned for repeat screening in the third year. 2) The mean time since last eye exam: will be reported for the entire cohort of new patients seen for screening. The proportion of patients whose last eye exam was >2 years prior will be calculated for the cohort. 3) Vision related quality of life (NEI VFQ 9) will be assessed for all participants. The associations of vision related quality of life with eye disease diagnosis and demographic variables will be assessed. The 2-year change in vision and vision related quality of life will be measured for all participants screened in the first year of the program and re-screened in Year 3.

Sample Size: Approximately 5,000 patients access the Hope Clinic per year and 25,000 patients access the Hamilton clinic per year. One technician will be assigned full-time to Hamilton. The other technician will split time between Hope (60%, Tuesday, Wednesday, Thursday) and Hamilton (40%, Monday and Friday) because there is such a higher volume of patients to screen at Hamilton and the Hope Clinic is not open on Mondays or Fridays. The clinic equipment at Hamilton will be set up to be used by both technicians. A typical day for each technician will include 5 screenings and 5 one-month follow-up visits. In the first 2 years (48 weeks each) at each site, all screenings will be of new or 1 year follow up patients. In the 3rd year, 2 will be new and 3 will be one or two-year re-screening visits. At Hope, the technician has capacity for 2448 new screenings and 432 repeat screenings in 4 years. At Hamilton, the technicians have capacity for 4872 new screenings and 1008 re-screenings in 3.5 years. Thus full capacity is 7320 new screenings and 1440 re-screenings. Operating at just 80% capacity enrolls over 5,800 patients for new screenings including over 1100 with 2-year re-screenings to determine impact on longer term visual acuity and visual function.

Data Analysis

Primary Outcome Analysis: The primary outcomes will be the number of participants screened, the prevalence of glaucoma/glaucoma suspect diagnosis and the cost per case of detected disease. related macular degeneration) will be summarized similarly. Based on the anticipated sample size (n=5800), the margin of error is at most 1.2 percentage points for the overall prevalence (but could be larger for annual and by-site estimates).

Aim 3: Integrate personalized glaucoma education and counseling during the technician visit and test the behavior intervention's impact on adherence to follow-up care with an ophthalmologist.

Overall strategy and experimental rigor.

In Aim 3, we will refine and optimize our eHealth-based, personalized education and counseling intervention that improves glaucoma medication adherence to also help support people in prioritizing returning for glaucoma care. This intervention uses a web-based application to generate personalized education materials for patients based on their diagnosis, test results, doctor's recommendations, and barriers to following those recommendations. A glaucoma counselor trained in brief, glaucoma-specific motivational interviewing (MI) uses the

individualized content generated from this web- based application to form the basis of her conversation with the patient. The glaucoma counselor uses MI- based communication strategies – including open-ended questions, reflective listening, and asking permission to give advice – to engage the person in identifying their own barriers to participating in glaucoma follow-up care and brainstorming their own solutions. All patients who screen positive for a diagnosis of glaucoma or glaucoma suspect and are being referred for an in-person examination with an ophthalmologist and who speak English will be randomized to receive either A) a 30-minute session with help scheduling the follow up appointment with an ophthalmologist and an educational hand-out or B) a 60-minute session with help scheduling the follow-up appointment with an ophthalmologist and a personalized counseling and education session about glaucoma. Spanish speaking participants will not be randomized and will receive personalized counseling and education about glaucoma. As of March 2024, Spanish speaking participants will be asked to choose eHealth education or standard education.

Rationale for experimental design.

Both empowerment theory and self-determination theory form the basis for our health and counseling intervention. The World Health Organization describes empowerment as a "process through which people gain greater control over decisions and actions affecting their health." Empowerment is particularly important for people who may experience a powerlessness that can come with minority status or poverty. To empower people to best manage their eye health, people must be supported to develop knowledge and skills about their health condition, coping skills for managing emotions that can negatively affect self-management, and motivation to attain improved health. Self-determination theory posits that to change a health behavior, people must feel autonomously supported and connected to their health care provider, perceive that they are competent to engage in the behavior, and be motivated to change their behavior.

Thus, the two theories provide very similar frameworks for understanding how to help people improve their health behaviors. MI is a counseling style consistent with the frameworks of self-determination theory and empowerment theory. This counseling engages patients by discussing priorities and obstacles to facilitate intrinsic motivation to change health behavior. At its base is a belief that an individual must develop a personally compelling reason to motivate a change in behavior for that change to happen.

Research design- Intervention

Block randomization: Subjects will be randomized to one of two treatment arms (standard glaucoma education from handouts or personalized education with counseling) in a 1:1 ratio. The time of randomization is when the patient returns for their follow-up visit with the ophthalmic technician. Randomization will occur separately for the two clinics (stratification). A variable-block randomization scheme will be used to assure balanced assignment to the treatment arms throughout the study.

Leveraging eHealth to provide personalized glaucoma education and counseling: The web-based application for personalized glaucoma education has two components woven together into a single tool to support the conversation between the patient and the glaucoma

counselor: 1) an electronic health (eHealth) component and 2) a semi-structured, tailored interview guide to facilitate an MI-based conversation. The eHealth component provides individually tailored disease information and an explanation of a patient's test results. The counselor uses the web-based application on a tablet, to share engaging audio-visual content on a screen. The counselor walks a patient through their diagnosis and test results and what would happen to their vision if glaucoma goes untreated. The counselor then elicits an understanding of what motivates that patient to maintain their vision. The counselor explores what unique obstacles the patient has to engaging in follow-up care. The counselor then assesses the patient's motivation to attend the follow-up appointment. The counselor and patient create a concrete "action plan" that delineates the short-term plan of the steps patient will take to address any identified barriers to follow-up care, which can include addressing motivational factors in a subsequent phone visit if a patient is not interested in follow-up care.

Throughout the program, the counselor helps patients put together a list of questions for their doctor to prepare for their visit. African-American patients are often less active in asking questions of health care providers,[63] so supporting question-asking during medical visits is a key modifiable patient engagement behavior. Creating a question prompt list for patients can improve patients' information recall after the doctor visit, reduces patients' anxiety about the visit, and improves self-efficacy for question-asking.[64] At the end of the visit, the counselor will print out a patient's action plan with their appointment time for the ophthalmologist, the list of questions to bring to the appointment, and login information in case the patient would like to access the website to view their education plan remotely.

Between 2-6 weeks after the counseling session, depending on when the glaucoma follow-up appointment is scheduled, the ophthalmic technician will make at least 3 attempts to contact within a 30 day window to schedule a phone call with the patient. During this phone call, the technician will remind the patient of when their upcoming appointment is scheduled. S/he will assess a patient's motivation and confidence in attending the visit and elicit possible obstacles. S/he will help the patient brainstorm possible solutions to identified obstacles and end the conversation by summarizing a new action plan. If needed, the counselor can arrange a subsequent phone call before the follow-up appointment to check-in about any outstanding problems. Patients will have the counselor's phone number to call if they need additional help.

Training para-professional staff in brief, glaucoma-specific motivational interviewing: We have developed a 2- day training program in brief, glaucoma-specific MI. [65] The program focuses on teaching the five core skills of MI: 1) asking open-ended questions; 2) affirming; 3) reflecting; 4) summarizing; 5) asking permission to provide information and advice.[57] These skills help elicit "change talk," through which counselors help patients talk themselves into changing their usual behavior, which in this case will be to ensure they attend their glaucoma follow-up care appointment. The program also teaches the counselor how to express empathy, with is the key component that underlies the spirit of MI and promotes rapport between the counselor and the patient.

During the first day of training, counselors are taught to ask open-ended questions, or questions that cannot be answered with a "yes" or "no" response. They learn reflective listening, or para-phrasing what a person has said to ensure the person knows the counselor

is hearing and understanding what they say. They learn to use affirmations to praise actions people are taking towards improving their health and vision. They learn to use the elicit-provide-elicit technique to give information. This involves assessing people's knowledge prior to giving information, asking permission to give new information or advice, and then following up by eliciting the person's response to the new information in order to evaluate their understanding. This non-directive way of giving advice and information supports people's autonomy. During the second day of training, counselors are taught how to make complex reflections.

Complex reflections are statements that para-phrase what a person has said and adds significant meaning to help make a person think about the implications of their statement. Counselors learn how to promote change talk and develop an action plan to adhere to follow-up care recommendations.

Role playing is used to develop these skills using a video collection of glaucoma patients explaining their reasons for not engaging in their glaucoma management. The training consists of approximately 35% didactic material and 65% role-playing and interactive learning.

Primary outcome: The primary outcome will be adherence to the recommended follow-up appointment with the ophthalmologist within 6 months due to availability in scheduling these appointments. Six-month adherence will be used as the endpoint for all participants. Adherence in each treatment group will be calculated as the proportion of patients who attended the initial scheduled follow-up visit with an ophthalmologist as recommended after being diagnosed with glaucoma or glaucoma suspect on screening exam, dividing by the total number of patients diagnosed with glaucoma or glaucoma suspect during the screening exam and scheduled for follow-up with an ophthalmologist. This objective outcome variable will be assessed through record review by the study coordinator who is masked to the treatment allocation.

Maintaining Fidelity to Treatment Allocation: All counseling/education encounters will be audio-recorded. A study therapist and MI trainer, will assess a random sample of 10% of encounters (n=40) for fidelity to MI-based counseling. She will be masked to treatment allocation though the personalized counseling sessions will be longer than standard education. She will assess each encounter according to the modified One Pass[71] grading system, a rubric with 17 items that assesses fidelity to MI counseling techniques. Each item is scored on a Likert scale from 1 to 7 and a passing score is set at a mean of 5. Counselors should not be using motivational interviewing-based counseling in the control group and therefore should have an average One Pass score <5 for these participants.

Data Analysis

Primary outcome: The primary outcome (attendance to follow-up appointment with a glaucoma specialist within three months) will be summarized with frequencies and percentages by intervention and control groups, overall and stratified by site.

Data Sharing

Participant data will be combined and shared with the Westat Corporation, a data analysis service, working with the CDC. Data will contain no PHI.

DATA AND SAFETY MONITORING PLAN

Dr. Musch will lead the study team in quarterly review of study recruitment, adverse events, and compliance with the protocol. These quarterly reports will also be reviewed at CAB meetings. Dr. Musch will work with Ms. Niziol to prepare monthly reports of recruitment, retention, and adverse events for the entire team. Any physical, social, economic, or psychological harm attributable to participation in the research study, if serious, will be reported to the IRB within 7 days. Any non-serious adverse events will be reported with scheduled continuing review to the IRB. Examples of possible adverse events include injury occurring during a study visit, breach of confidentiality, or auto accident on the way to or from the study visit. Any unrelated deaths while in the study will be reported to the IRB with scheduled continuing review.

The proposed tele-health protocols for glaucoma screening have been developed, validated and approved by the Veterans Affairs Hospital and those guidelines will be followed for triaging any urgent disease identified through screening. If a person requires urgent or emergent ophthalmic care at Hamilton Clinic, the ophthalmologist at Hamilton will be paged and will take responsibility for ensuring that the patient receives appropriate care. If a person at Hamilton Clinic needs urgent surgical glaucoma care, the ophthalmologist will page a study team Ophthalmologist who will contact UM staff to help arrange transportation for the patient to the Kellogg Eye Center. If a person requires urgent or emergent attention at Hope Clinic, the Hope medical director, the physician providing care at Hope during this time and Dr. Newman-Casey will be paged and take responsibility for ensuring the patient receives appropriate care. If a patient needs urgent surgical glaucoma care, Hope Clinic staff will help Dr. Newman-Casey arrange transportation for the patient to the Kellogg Eye Center for care.

RESEARCH SHARING AND DATA MANAGEMENT PLAN

Data entered in REDCap will be identified only through a participant ID number. The participant ID numbers will be linked to patient identifiers in a single Excel document that is password protected and accessible only to members of the study team. It will be kept on a HIPAA secure, encrypted file sharing service, M+Box or UM server, provided by the University of Michigan. Using REDCap for data entry by its nature makes data easier to share by coding data using common terminologies and data elements. The REDCap database elements will be archived and stored on HIPAA secure, low-cost storage (MiStorage) at the University of Michigan.