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Patient Navigators Improve In-Office Eye Exam Adherence After Community Eye Screenings in a Randomized Clinical Trial: NYC-SIGHT Study

LISA A. HARK,
PRAKASH GORROOCHURN,
LAURA T. PIZZI,
ERIC JUTKOWITZ,
ANNETTE M. GOULAK,
STEFANIA C. MARURI,
NOGA HARIZMAN,
JASON D. HOROWITZ,
LISA PARK,
QING WANG,
DANIEL F. DIAMOND,
IVES A. VALENZUELA,
DESIREE R. TORRES,
YUJIA WANG,
TARUN SHARMA,
JEFFREY M. LIEBMANN,
GEORGE A. CIOFFI

Department of Ophthalmology (L.H., A.G., N.H., J.H., L.P., Q.W., D.D., I.V., T.S., J.L., G.C.),
Columbia University, Vagelos College of Physicians and Surgeons, New York, New York, USA.;
Edward S. Harkness Eye Institute (L.H., S.M., N.H., J.H., Q.W., D.D., I.V., D.T., Y.W., T.S., J.L.,

Inquiries to Lisa A. Hark, Columbia University Vagelos College of Physicians and Surgeons, New York, New York 10032, USA;
lahl12@cumc.columbia.edu.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

LISA A. HARK: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **PRAKASH GORROOCHURN:** Writing – review & editing, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **LAURA T. PIZZI:** Writing – review & editing, Writing – original draft, Resources, Methodology, Conceptualization. **ERIC JUTKOWITZ:** Writing – review & editing, Writing – original draft, Resources, Methodology, Conceptualization. **ANNETTE M. GOULAK:** Writing – review & editing. **STEFANIA C. MARURI:** Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation. **NOGA HARIZMAN:** Writing – review & editing, Resources, Methodology, Investigation. **JASON D. HOROWITZ:** Writing – review & editing, Resources, Methodology, Investigation, Conceptualization. **LISA PARK:** Writing – review & editing, Resources, Methodology, Investigation, Conceptualization. **QING WANG:** Writing – review & editing, Resources, Methodology, Investigation. **DANIEL F. DIAMOND:** Writing – review & editing, Resources, Methodology, Investigation. **IVES A. VALENZUELA:** Writing – review & editing, Resources, Methodology, Investigation. **DESIREE R. TORRES:** Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation. **YUJIA WANG:** Writing – review & editing, Software, Resources, Project administration, Methodology, Investigation. **TARUN SHARMA:** Writing – review & editing, Resources, Methodology. **JEFFREY M. LIEBMANN:** Writing – review & editing, Resources, Methodology, Funding acquisition, Conceptualization. **GEORGE A. CIOFFI:** Writing – review & editing, Resources, Methodology, Funding acquisition, Conceptualization.

G.C.), Columbia University Irving Medical Center, New York, New York, USA.; Department of Biostatistics (P.G.), Columbia University Mailman School of Public Health, New York, New York, USA.; Center for Health Outcomes, Policy, and Economics (L.P.), Rutgers University Ernest Mario School of Pharmacy, Piscataway, New Jersey, USA.; Department of Health Services, Policy & Practice (E.J.), Brown University School of Public Health, Providence, Rhode Island, USA.

Abstract

- **PURPOSE:** To assess the effectiveness and cost of patient navigators in improving adherence to an initial in-office eye exam following community-based eye health screenings and referral to ophthalmology among underserved populations.
- **DESIGN:** 5-year prospective, cluster-randomized **clinical** trial.
- **PARTICIPANTS:** Eligible individuals aged 40 years and older were recruited from affordable housing developments and senior centers in Upper Manhattan.
- **METHODS:** Demographics, social determinants of health, clinical characteristics, and access to eye care were collected. Eye health screenings included visual acuity, intraocular pressure, and fundus photography. Those diagnosed with glaucoma, suspected glaucoma, retinal abnormalities, cataracts, or other ocular conditions were referred for in-office eye exams, with initial appointments scheduled by study staff. Navigator Intervention participants received appointment scheduling support for 10 months, Usual Care participants did not receive navigator assistance. T tests, chi-square tests and multivariate stepwise logistic regression analyzed factors associated with adherence. Cost-effectiveness analysis was conducted alongside the study.
- **MAIN OUTCOME MEASURES:** Adherence to the initial in-office eye exam for those referred to ophthalmology.
- **RESULTS:** Of 468 referred participants, 47% (n = 220/468) attended the initial in-office eye exam. Adherence rates: Navigator Intervention (51.8%) versus Usual Care (38.1%). Of those who attended the in-office eye exam, mean age: 70.2 ± 11.3 years; 65.5% female; 46.8% African American, 47.3% Hispanic. Participants in the Navigator Intervention group had higher odds of adhering to the initial in-office eye exam compared to those receiving Usual Care (OR = 1.529; 95% CI (1.023, 2.285)). Participants who spoke English as their primary language also had higher odds of adhering to the initial eye exam (OR = 1.815; 95% CI (1.211, 2.721)). Cost per participant in the Navigator Intervention group who attended the in-office eye exam: \$24.25 vs. \$33.03 per Usual Care participant.
- **CONCLUSIONS:** Patient navigators improved adherence to in-office eye exams following community-based eye health screenings and referral to ophthalmology among an underserved population. The Navigator Intervention resulted in cost savings with an incremental cost-effectiveness difference of \$8.78 less per participant randomized to the Navigator Intervention group. (*Am J Ophthalmol* 2025;274: 54–66.

INTRODUCTION

According to the United States (US) Centers for Disease Control and Prevention (CDC), glaucoma, diabetic retinopathy, cataracts, and age-related macular degeneration are the

leading causes of vision impairment and blindness in the US, representing significant public health problems and increasing medical expenses.^{1,2} Underserved populations bear a disproportionate burden of these eye diseases, which significantly affect quality-of-life.^{3–5} Abundant evidence indicates that vision and eye health disparities exist due to multilevel social determinants of health (SDOH) which act as barriers to eye care, with multiple studies finding clear associations between SDOH and vision impairment.^{3–8} The National Eye Institute (NEI)'s Strategic Plan: *Vision for the Future 2021–2025* highlights the need to address multi-level SDOH to improve detection and reduce eye disease burden in underserved communities.⁸

Patient navigators have emerged as a promising intervention following community-based eye health screenings to support follow-up eye care, however, more research is needed to test implementation strategies in ophthalmology.^{9–11} Dohan and Schrag identified 2 types of definitions for patient navigation, both of which directly address SDOH: “service-focused” and “barrier-focused,” and we believe both are applicable to the field of ophthalmology.¹² Based on the service-focused definitions, patient navigators can connect individuals to resources (eye health screenings) and assist participants in scheduling appointments if they are referred for in-office eye exams (access to care). Barrier-focused definitions explain that patient navigators identify and help remove impediments (such as transportation) that prevent participants from attending in-office eye exams, adhering to follow-up appointments, taking medications, and/or undergoing laser treatment or ocular surgery.^{13–14}

In 2019, Columbia University Department of Ophthalmology (Principal Investigator L. Hark) received 5 years of funding through a CDC Cooperative Agreement: *Improving Detection and Management of Glaucoma and Other Eye Diseases Among High-Risk Populations*.^{15,16} This community-based eye health screening study, (NYC-SIGHT), aimed to better engage populations most at risk and least likely to have access to eye care in order to detect and manage glaucoma and other ocular diseases.¹⁶ The study reached underserved populations with the greatest need for eye care by targeting neighborhoods of Harlem (65% African American race) and Washington Heights (70% Hispanic/Latino ethnicity) and tested a Navigator Intervention to support in-office eye exam adherence for those referred to ophthalmology for in-office eye care and ocular testing/imaging.¹⁶

This paper describes demographics, SDOH, and clinical factors associated with adherence to an initial in-office eye exam among individuals referred to ophthalmology following community-based eye health screenings. The paper also presents the cost analysis and cost per case detected for those who attended the in-office eye exam.

METHODS

• STUDY DESIGN:

The NYC-SIGHT is a 5-year prospective, cluster-randomized clinical trial. Details regarding the methods, baseline results, and referral to ophthalmology rates have been previously described in detail.^{16–18} The New York City Housing Authority (NYCHA) development (location) was chosen as the unit of randomization, and 10 developments in Harlem and Washington Heights provided access to 6640 underserved residents who live in

close proximity to the Columbia University Harkness Eye Institute and Harlem Hospital Ophthalmology. These developments have a high proportion of men and women of diverse race/ethnicity with high rates of inadequate eye care. A 2:1 cluster randomization scheme was established by the study biostatistician, with 7 developments assigned to the Navigator Intervention and 3 developments assigned to Usual Care. A cluster-randomized design was chosen to prevent contamination. It would be impossible to provide vision screening, eye exams and eyeglasses to only some residents living in the same housing development, as crossovers would be common and dissatisfaction in the comparison arm would be likely.

This 2:1 cluster randomization study design (by housing development) aimed to increase the number of participants receiving the Navigator Intervention, based on the hypothesis that over 1- year, study participants referred to ophthalmology following a community-based eye health screenings and randomized to the Navigator Intervention group will have 60% adherence to the initial in-office eye exam compared to 40% in Usual Care.

Columbia University Irving Medical Center Institutional Review Board (IRB)/Ethics Committee (#AAAR9162) approved the study and all aspects adhered to the tenets of the Declaration of Helsinki and are in compliance with the Health Insurance Portability and Accountability Act (HIPAA). Informed consent was obtained from all participants prior to enrollment and the study was registered on [ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT04271709) (NCT04271709) on 2/20/2020.

- **TARGET POPULATION:**

Recruitment occurred in Harlem and Washington Heights, targeting individuals living at or below the [NYC.gov](https://www.nyc.gov) poverty measure.¹⁹ Target enrollment was 1500 participants, which was approximately 22% of the sample frame of 6640 (number of adults and seniors living in the 10 NYCHA developments), however, study enrollment was delayed for 1 year during the COVID-pandemic, and when recruitment was resumed in 2021, 10% of NYCHA residents participated.

- **INCLUSION CRITERIA:**

Eligible participants were individuals aged 40 years and older living in a NYCHA affordable housing developments or members of Department for the Aging (DFTA) senior center aged 60 years and older who consented to an eye health screening.¹⁶ Those who met the study's inclusion criteria provided consent over the telephone or in person, in English or Spanish, by the bilingual trained study coordinators, who also conducted the prescreening assessments.

- **PRESCREENING ASSESSMENT:**

Demographic and Social Determinants of Health: Participants reported their date of birth, sex, race/ethnicity, education level, health insurance type, employment status, marital status, and preferred transportation methods to medical appointments.

Clinical Characteristics: Medical and ocular conditions, prescription eyeglasses use, and family history of glaucoma and blindness were documented.

Access to Eye Care: Participants were asked if they ever had a dilated eye exam and if so, approximately when was their last dilated eye exam and their transportation method to this appointment. Participants were also asked if they are currently under the care of an eye doctor and would they like to follow-up with him or her if referred to ophthalmology.

- **PROCEDURES:**

Eye Health Screenings: Eye health screenings were conducted in community rooms at NYCHA developments or DFTA senior centers. Visual acuity was measured by trained community health workers using the Snellen eye chart at 20 feet with correction.^{16,20} Trained ocular technicians measured intraocular pressure (IOP) in both eyes using the Ic100 iCare rebound tonometer (iCare, Helsinki, Finland).¹⁶ In a darkened space, 2 nondilated fundus images of the optic disc and macula of each eye were taken by a trained ocular photographer using an autofocus, hand-held fundus camera (Volk, Pictor Prestige, Mentor, Ohio, USA). Within 24 hours, these images were uploaded by the ocular photographer to a HIPAA-compliant cloud-based database (Forum, Zeiss Oberkochen, Germany). The images were read and graded by 1 study ophthalmologist specializing in retina and 1 specializing in glaucoma.²¹ Final reading results were based on the worse eye and classified as normal or abnormal with no significant findings, abnormal with significant findings, or unreadable.

Screening Failure: Those with visual acuity 20/40 or worse in either eye, IOP 23–29 mmHg, or an unreadable image “failed” the eye health screening and were scheduled to see the study optometrist within 3 weeks in the same community-based location. Participants with an IOP ≥ 30 mmHg were “fast-tracked” and immediately scheduled with ophthalmology for an in-office glaucoma evaluation within 2 weeks. Those with an abnormal fundus image with significant findings were also referred directly to ophthalmology.

Community-Based Optometric Exam: For those who failed the screening and attended the optometric exam, an ocular technician performed an autorefractor (QuickSee Autorefractor, Plenoptika, Cambridge, MA, USA) to assess for refractive error. The optometrist performed a Trial Lens refraction and conducted a nondilated anterior segment exam using a portable slit lamp and a posterior segment exam using a direct ophthalmoscope (Welch Allyn Panoptic 3.5V, Skaneateles Falls, NY) to detect ocular abnormalities. The optic nerve exam for diagnosing glaucoma and glaucoma suspect was based on the *American Academy of Ophthalmology (AAO) Preferred Practice Pattern Guidelines*.²² The optometrist also diagnosed cataracts, retinal abnormalities, and other ocular conditions and referred participants to ophthalmology for an in-office dilated eye exam and further ocular testing/imaging as deemed necessary, and the “reasons for referral” results have been previously published.^{23–24}

Referral for In-Office Eye Exams: All participants referred to ophthalmology for an in-office eye exam, either due to an IOP ≥ 30 mmHg, an abnormal fundus image finding, or ocular conditions confirmed by the optometrist, were scheduled for an initial in-office eye exam by the study staff within 6 months (+4 months). All eye exam dates were documented in the Research Electronic Data Capture (REDCap) and study staff reviewed

EPIC electronic medical records (EMR) each time a participant was scheduled in-order to document appointment adherence over 10 months.

Navigator Intervention Group: Participants in the Navigator Intervention group received additional telephone-based support over a 10-month period from trained patient navigators, specifically with scheduling, rescheduling, and eye exam appointment reminders, and if requested, transportation assistance was provided. Navigator Intervention participants who did not attend the initial eye exam were contacted by the patient navigators and rescheduled. Reasons for not attending were captured in the REDCap call log to assess barriers to adherence.

Usual Care Group: Participants in the Usual Care group referred to ophthalmology were only called to share abnormal image findings and schedule the initial in-office eye exam; they did not receive ongoing eye exam scheduling or transportation support after the initial appointment. Usual Care participants were not contacted if they missed the in-office eye exam.

Definition of Adherence: Attendance at the initial in-office eye exam is the primary outcome of the trial.¹⁶ Participants were considered adherent if they attended the recommended initial in-office eye exam within 10 months of the community-based screenings since appointments were scheduled within 6 months after screenings, and an additional 4-month window was permitted in case of rescheduling. Participants who chose to receive follow-up eye care from their own ophthalmologist and did not sign a medical release form were excluded from the analysis.

In-Office Ocular Diagnoses, Follow-up and Treatment

Recommendations: Participants who attended the initial in-office eye exam were recommended to follow-up at a variety of intervals depending on their ocular condition(s), including within 4 weeks, 1–2 months, 3–5 months, 6–11 months, or 12 months. Ocular diagnoses were confirmed, and treatment recommendations were captured from the EMR and documented in REDCap by study staff for statistical analysis.

Statistical Analysis: Study data were collected and managed using the REDCap database hosted at Columbia University Mailman School of Public Health and are summarized using means and standard deviations for continuous variables and frequencies, and percentages for categorical variables. Data analysis was performed in IBM SPSS Version 28 (IBM Corp. Armonk, NY).²⁵

Primary outcome measure was adherence to the initial in-office eye exam. The randomization groups (Navigator Intervention vs. Usual Care) were compared in terms of demographics and SDOH variables (ethnicity, race, age, sex, employment, education level, marital status, insurance type, transportation needs). Predictors of adherence variables included randomization group, demographic characteristics, SDOH, self-reported medical and ocular history, and eye health screening results.

Assessment of the Primary Outcome: A 2-sample t-test was used to compare mean age between those who attended and those who did not attend the initial in-office eye exam. For categorical variables, chi-square tests were conducted to assess differences in adherence rates. Variables that demonstrated statistical significance were then included in a multivariate stepwise logistic regression model to assess their association with adherence, while adjusting for other variables that were also significant. The stepwise logistic regression model was used because a large number of variables were significant in the univariate analyses. At each step, variables were added based on the alpha-to-enter significance level of 0.05 and the alpha-to-remove significance level was set at 0.1 to exclude variables in the final model. For all analyses, P values of $< .05$ were considered statistically significant and all tests performed were 2-sided. Odds ratios (OR) were estimated with 95% confidence intervals (CI).

Cost Analysis: A cost analysis was conducted alongside the study to identify staff time and resources of delivering the eye health screenings and optometric exams in a real-world community setting. The cost analysis methods have been previously published and are described in detail.¹⁷

Cost Measures Inventory and Assumptions: Cost measures included staff time costs for the on-site eye health screenings, equipment, supplies, optometrist eye exams, personal protective equipment, and travel costs to the sites. Staff time costs were calculated using the Activity-Based Costing method, a micro-costing approach which quantifies the monetary value of personnel required to deliver the screening based on the time and resources required.²⁶ During the study, staff logged time spent on implementation tasks in minutes. Since this recorded time did not include time spent managing the program and overhead (indirect costs), we multiplied their recorded time by a factor of 3 to arrive at a more realistic estimate. All time costs were converted to dollars by multiplying time spent performing each task by hourly wage rates, obtained from 2021 US Bureau of Labor Statistics (BLS) data for the specific types of staff involved (ophthalmic medical technician \$19.77/hour, optometrist \$60.31/hour, and ophthalmologist \$129.85/hour).²⁷ The ophthalmologist time was required for image reading only, since they were not otherwise involved in delivering the intervention. All staff time costs were then inflated by 30.4% to account for fringe benefits. Costs for equipment (without depreciation value), travel, and supplies were obtained from financial accounting records. There were no rental costs for any of the spaces, therefore rental costs and depreciation were not included in the cost analysis. Since the goal of the cost analysis was to estimate the costs of delivering the eye health screening in a real-world community setting, we excluded all costs associated with research, including but not limited to, IRB approval and maintenance, research training, research data collection, investigator meetings, obtaining informed consent, research-related travel, and principal investigator time spent on study oversight.

Cost of Navigator Intervention versus Usual Care: We calculated the costs of delivering the Navigator Intervention by tracking the time patient navigators spent coordinating eye exam appointments and arranging transportation for participants referred to ophthalmology using a REDCap call log. Patient navigators and their approximate wage

rate plus fringe benefits was costed using the same approach as previously summarized for screening personnel. For those referred to ophthalmology after the screenings, navigators and study staff logged start and end time in minutes using the REDCap call log during all contact with study participants. Time costs were calculated using the Activity-Based Costing method.²⁶ Since this recorded time did not include time spent managing the program and overhead (indirect costs), we multiplied their recorded time by a factor of 1.5 to arrive at a more realistic estimate. All time costs were converted to dollars by multiplying time spent performing each task by hourly wage rate for the patient navigators and study staff (\$25.78/hour including fringe benefits), which was obtained from 2021 US Bureau of Labor Statistics (BLS) data.²⁷ Costs of patient navigators were compared to the staff time contacting Usual Care participants.

Cost Effectiveness: For those referred to ophthalmology, we calculated the cost per case for any detected eye disease and cost per participant who attended the in-office eye exam and compared costs between Navigator Intervention and Usual Care participants.

RESULTS

A total of 708 participants completed eye health screenings in community settings from March 1, 2021 to May 31, 2022 and 468 participants were referred to ophthalmology (66.1%) for in-office eye exams and ocular testing/imaging. As shown in Table 1, no differences were noted in age, sex, employment, or health insurance. Significant differences were noted between the characteristics of referred participants in the Navigator Intervention and Usual Care groups. For example, the Navigator group had more participants who self-identified as Hispanic ethnicity ($P < .001$), spoke Spanish ($P < .001$), had higher education levels ($P = .005$) and were more likely to be married or have domestic partner ($P = .048$) (Table 1).^{17,18} The majority of participants across both groups had health insurance (97%), at least 73% wore eye glasses, yet 68.5% in the Navigator group and 65.6% in the Usual Care group reported no access to an eye care provider.

Navigator Intervention Findings:

Of the 468 participants referred (Navigator Intervention: $n = 305$, Usual Care: $n = 163$), 220 participants (47%) adhered to the initial in-office eye exam; of these, 158 participants (51.8%) were randomized to the Navigator Intervention group versus 62 participants (38.1%) from the Usual Care group, demonstrating a significantly greater proportion of participants randomized to the Navigator Intervention group attending the in-office eye exam ($P = 0.004$) (Table 1 and Figure 1). Reasons for not attending the in-office eye exam are shown in Figure 1.

Demographics:

Baseline demographic and clinical characteristics for those who attended the in-office eye exam, compared to those who did not attend, are shown in Table 2. Those who adhered ($n = 220$) had a mean age of 70.2 years (standard deviation [SD] ± 11.3) (age range 40–98 years), with the majority (60.9%) aged 60 to 79 years. Additionally, 65.5% were female; 46.8% were of African American race; and 47.3% were of Hispanic ethnicity.

Social Determinants of Health:

Most participants who attended the initial in-office eye exam were single (76.4%), retired (63.2%), and had completed less than high school or high school education (64.6%). A significant proportion of participants who adhered (43.6%) spoke Spanish as their primary language ($P < 0.001$) (Table 2).

Ocular and Medical History:

As shown in Table 2, of the 220 participants who adhered to the in-office eye exam, 67.7% self-reported hypertension and 31.4% self-reported diabetes. Additionally, of those who adhered, 21.4% of participants self-reported a family history of glaucoma and 19.1% self-reported glaucoma, both significantly different than those who did not adhere ($P = 0.026$). Regarding access to eye care, 40% of participants who completed the initial in-office eye exam had not had a dilated eye exam in the past 2 years, and 7.3%, or 16 participants had never had an eye exam.

Eye Health Screenings:

Of 220 participants who adhered to the initial in-office eye exam, 82.3% failed the eye health screenings based on visual acuity 20/40 or worse, 11.4% failed due to IOP 23–29 mmHg, and 21.4% failed due to having an unreadable image, with some having multiple reasons for failure (Table 3).

Multivariate Stepwise Logistic Regression:

As shown in Table 4, participants in the Navigator Intervention group had higher odds of adhering to the initial in-office eye exam compared to those receiving Usual Care (OR = 1.529; 95% CI (1.023, 2.285); $P = 0.038$). Similarly, participants who spoke English as their primary language had higher odds of adhering to the initial eye exam (OR = 1.815; 95% CI (1.211, 2.721); $P = 0.004$). Participants with Medicaid insurance showed lower odds of adhering to the initial eye exam compared to those with Medicare or private insurance (OR = 0.636; 95% CI (0.430, 0.941); $P = 0.023$). Participants who self-reported glaucoma also had lower odds of adhering compared to those without pre-existing glaucoma (OR = 0.585; 95% CI (0.345, 0.994); $P = 0.047$) (Table 4). Although the initial chi-square test suggested that Hispanic participants and those who spoke Spanish as their primary language showed significantly higher adherence to in-office eye exams, the multivariate stepwise regression analysis revealed that Hispanic ethnicity and Spanish as a primary language were not significant predictors of adherence (Table 4).

Ocular Diagnosis at Initial In-Office Eye Exam:

The initial in-office eye exams revealed a range of confirmed ocular diagnoses. Cataracts were the most common diagnosis, affecting 81 participants (36.8%), while the combined total of glaucoma and glaucoma suspect diagnoses accounted for 101 participants (45.9%). Other notable conditions included retinal abnormalities (14.1%), diabetic retinopathy (9.1%), and macular degeneration (7.3%).

Treatment and Follow-Up Recommendations:

A variety of recommended treatment options ranged from close monitoring to ocular surgical and laser procedures. The majority of treatment recommendations were to 1) wait, watch, and follow IOP (57.7%); 2) prescribed IOP-lowering eye drops (20.9%), and 3) over-the-counter eye drops or ointment (16.4%). Additionally, 11.4% of participants were recommended for cataract surgery, while 7.3% were recommended for retinal or glaucoma surgery, including laser treatment. Follow-up recommended intervals were available in the EMR for 149 participants and ranged from within 4 weeks to 12 months for the next in-office dilated eye exam and ocular testing/imaging appointment.

Cost Analysis Results:

The mean total staff time required to deliver the eye health screening and optometric exam was 40.12 minutes +16.04 per participant. The individual components of the cost analysis included:

- Eye health screening (12.28 minutes +4.01).
- Appointment management/scheduling (13.92 minutes +11.86).
- Optometric exam time was 5.53 minutes +6.59 for the total number of participants.
- For the 308 of 708 participants (43.5%) who received this optometric exam, mean optometric exam time was 11.44 minutes +4.71.
- Total mean staff time cost, including all components, was \$76.29 + \$33.27 per participant.
- Total cost of equipment, travel, and supplies was \$103.96 per participant.
- Total cost per participant was \$180.88.
- For those referred to ophthalmology for the in-office eye exam, the cost per case of eye disease detected was \$273.64, based on the costs of delivering the program divided by the number of participants referred to ophthalmology (n = 468).¹⁷

• COST OF THE NAVIGATOR INTERVENTION COMPARED TO USUAL CARE:

- Among the 468 participants referred to ophthalmology (trial sample), 3204 telephone calls were made, with a mean total duration of all calls of 9121 minutes, which cost \$5879 or \$13 per participant.
- Participants in the Navigator Intervention group received a total of 2349 calls (\$8.19 per participant) related to in-office eye exam appointments over 10 months.
- Participants in Usual Care received 855 calls (\$4.38 per participant) related to an abnormal image requiring referral and to schedule initial in-office eye exam appointments.

- Of those participants referred to ophthalmology and reached by telephone, patient navigators spent additional time with scheduling and reminder telephone calls to confirm in-office eye exams, reschedule no-show or cancelled appointments, coordinating care with other eye doctors, and arrange transportation if requested.
- **COST EFFECTIVENESS:**
 - Cost per participant who attended the initial in-office eye exam for the Navigator Intervention group was \$24.25 (total cost of phone calls [\$3,830.91]/number of attended in-office appointments [n = 158]).
 - Cost per participant who attended the initial in-office eye exam for Usual Care was \$33.03 (\$2,047.58/62).
 - The Navigator Intervention compared to Usual Care was cost saving with an incremental cost-effectiveness difference of \$8.78 less per participant randomized to the Navigator Intervention group.

DISCUSSION

The Manhattan Vision Screening and Follow-Up Study (NYC-SIGHT) serves as a novel cluster-randomized clinical trial conducted in affordable housing developments and senior centers in Upper Manhattan. The NYC-SIGHT study incorporated patient navigators to support participants referred to ophthalmology to improve adherence to in-office eye exams by providing telephone-based appointment scheduling assistance and transportation if requested. This study offers a comprehensive understanding of the factors associated with adherence and compelling evidence supporting the beneficial role of patient navigators in helping underserved populations who may face disproportionate barriers to accessing adequate eye care.^{1–8} Of the 220 screened participants who attended the initial in-office eye exam, a significantly greater proportion of participants (51.8%) were supported by patient navigators who assisted with telephone-based scheduling, appointment confirmation, and rescheduling.

The multivariate stepwise logistic regression model further reinforced the utility of the Navigator Intervention, as participants who received this support had significantly higher odds of adhering to the initial in-office eye exam compared to Usual Care participants. These findings are consistent with prior studies in various medical fields that have shown improvement in follow-up care adherence when patients are supported by navigators.^{9–11,13,28–34} Additionally, participants who had English as their primary language also demonstrated significantly higher odds of adhering to the initial in-office eye exam. This aligns with existing literature, which identifies language barriers as a major obstacle to healthcare adherence, particularly in settings that rely on medical interpretation.³⁵ Although several bilingual staff members were present at our community screenings, future studies should explore expanding the use of bilingual personnel, including patient navigators, to further reduce language-related barriers to care.

Conversely, participants with Medicaid or self-reported glaucoma had significantly lower odds of adhering to the initial in-office eye exam. These results corroborate prior research indicating that Medicaid recipients with glaucoma are significantly less likely to receive necessary testing and care compared to those with commercial insurance.³⁶ The challenges faced by individuals with glaucoma in maintaining care are further compounded by SDOH, such as lower education and income levels, both of which were prevalent in the study population.³⁷ These findings underscore the urgent need to implement patient navigators to help reduce barriers to eye care, and future studies should investigate utilizing navigators to assist with insurance navigation.

Of participants who attended the in-office eye exam, only 30% reported having their own eye doctor, 40% had not undergone a dilated eye exam in over 2 years, and 7.3% never had an eye exam. These results further illustrate the necessity of additional assistance, such as that provided by patient navigators, to effectively mitigate eye health disparities and improve access to and utilization of eye care in high-risk, underserved populations.^{32–33}

- **STRENGTHS:**

This study considered social determinants by conducting eye health screenings in the community where participants live, thereby reducing access to care barriers. As hypothesized, more participants benefitted from the Navigator Intervention, justifying the 2:1 randomization study design. The study personnel scheduled in-office eye exams for all study participants referred to ophthalmology and provided patient navigation support at no cost to those in the Navigator Intervention group. This Navigator Intervention model could be crucial in improving eye care access and utilization in high-risk, underserved communities with the potential to be replicated and scaled in other settings.^{23,32,34} The cost to yield adherence to the initial in-office eye exam revealed the Navigator Intervention cost less (\$24.25 per participant) than Usual Care (\$33.03 per participant).

- **LIMITATIONS:**

Limitations of this study include the recruitment of adults and seniors from affordable housing in Upper Manhattan who self-selected to participate, which may not represent all high-risk populations in New York City or other urban settings. Although transportation was not a barrier in our urban setting, traveling to eye care providers may remain challenging in other geographic locations.²⁸ Further, the lack of a consistent definition for adherence limits comparability with prior studies that have investigated follow-up adherence. In addition, the economic analysis only considered the cost of conducting the phone calls. Other potentially relevant costs include those related to infrastructure support. In addition, the economic analysis evaluated cost per adherent office visit and did not consider quality adjusted life years. Lastly, factors such as physical disabilities were not investigated, and these may influence adherence to attending in-office eye exams. Addressing these limitations in future research will be essential to better understand and enhance eye care access and utilization in diverse populations.

To conclude, the NYC-SIGHT Study is a novel community-based eye health screening study that incorporated optometric exams and patient navigators following screenings

to improve in-office eye exam adherence in underserved participants who were referred to ophthalmology and tracked program costs. Among participants who adhered to the initial in-office eye exam, a significantly greater proportion received assistance from patient navigators (51.8%) compared to Usual care (38.1%), with the multivariate stepwise analysis confirming that participants in the Navigator Intervention group had higher odds of adherence. The cost per adherent in-office eye exam was lower in the Navigator Intervention compared to Usual Care. Based on these findings, we plan to continue partnering with NYCHA to scale eye health screenings in Upper Manhattan affordable housing developments to provide much needed evidence that may support policy changes to improve access to and utilization of eye care for underserved populations in the United States.

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DATA SHARING STATEMENT

All deidentified participant data, study protocol, statistical plan, and informed consent will be made available by the corresponding author upon email request. The data will be made available with investigator support after approval of a proposal and a signed data access agreement is fully executed. NYC-SIGHT *Clinical Protocol* and *Manual of Procedures* are available at [SIGHTSTUDIES.org](https://sightstudies.org).

Abbreviations:

CDC	Centers for Disease Control and Prevention
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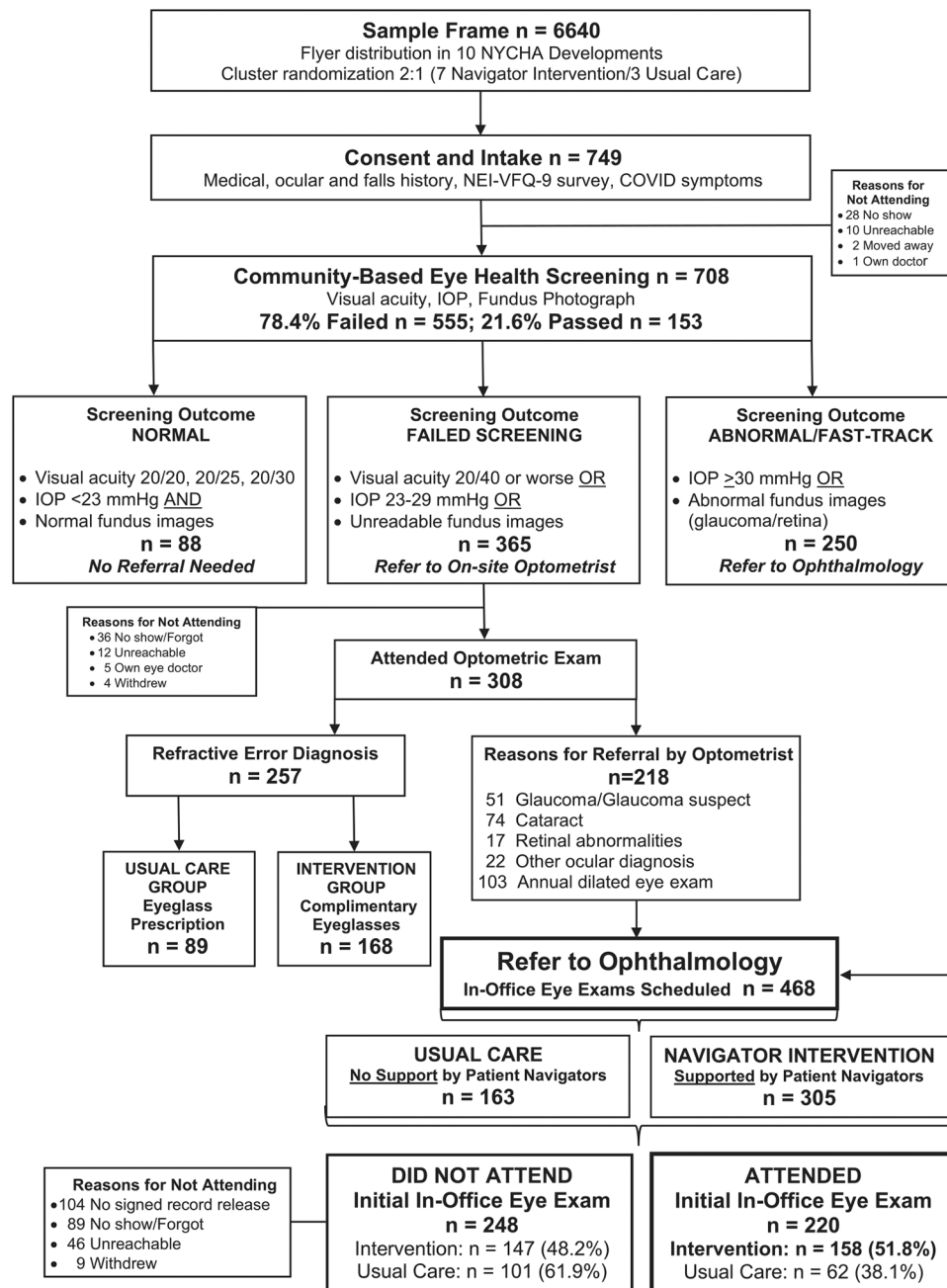
DFTA	Department for the Aging
EMR	Electronic medical record
HIPAA	Health Insurance Portability and Accountability Act
IOP	intraocular pressure
IRB	Institutional Review Board
logMAR	logarithm of the minimum angle of resolution
NEI	National Eye Institute
NYC	New York City
NYCHA	New York City Housing Authority
REDCap	Research Electronic Data Capture
SD	Standard Deviation
SDOH	social determinants of health
US	United States

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**FIGURE 1.**

CONSORT Diagram shows study flowchart. Participants were recruited via flyer distribution (Top center). Verbal informed consent, intake data, medical, ocular, and falls history, NEI VFQ-9 survey and COVID-19 history were obtained via the call center prior to eye health screening (second row). All enrolled participants were scheduled for eye health screenings at the NYCHA Developments and DFTA senior centers (third row). Reasons for not attending eye health screening (third row right). Eye health screening outcomes were normal, failed screening, or abnormal/fast-track (fourth row). All participants who failed the eye health screening were scheduled with the on-site optometrist (fifth row). Optometrist

diagnoses included refractive error (sixth row). Usual Care group received eyeglasses prescription only. Navigator Intervention group received complimentary eyeglasses (seventh row left). Total participants referred to ophthalmology (eighth row right). Intervention participants referred to ophthalmology were assisted by patient navigators while Usual Care group were not supported (ninth row). Total attendance at the initial in-office eye exam between Usual Care and Navigator Intervention groups (Last row). Reasons for not attending the in-office eye exam are shown (ninth row left).

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TABLE 1.
NYC-SIGHT: Adherence Rates, Demographics, and Social Determinants of Health for Participants Referred for Initial In-Office Eye Exam by Randomization Group (n = 468)

Variable	Navigator Intervention group (n = 305)	Usual Care group (n = 163)	P Value ^a
Age, mean (±SD)	69.43 (11.57)	71.13 (11.15)	.122 ^d
Age category, n, (%)			
40–59 years	66 (21.6)	23 (14.1)	.142
60–79 years	181 (59.3)	106 (65.0)	
≥80 years	58 (19.1)	34 (20.9)	
Sex, n, (%)			.337
Male	97 (31.8)	59 (36.2)	
Female	208 (68.2)	104 (63.8)	
Race/ethnicity, n, (%)			<.001
African American	149 (48.9)	109 (66.9)	
Hispanic ^b	135 (44.3)	50 (30.7)	
Others	21 (6.9)	4 (2.5)	
Education level, n, (%)			.005
Less than high school	96 (31.5)	42 (25.8)	
High school	113 (37.0)	45 (27.6)	
Some college, college graduate, or graduate degree	96 (31.5)	76 (46.6)	
Employment status, n, (%)			.078
Employed (full-time/part-time)	49 (16.1)	32 (19.6)	
Unemployed	35 (11.5)	11 (6.7)	
Retired	182 (59.7)	108 (66.3)	
Disabled/unable to work	12 (7.4)	12 (7.4)	
Marital status, n, (%)			.048
Single, divorced, separated, or widowed	224 (73.4)	133 (81.6)	
Married/Domestic partner	81 (26.6)	30 (18.4)	
Has health insurance, n, (%)			1.000 ^d
No	9 (3.0)	5 (3.1)	
Yes	296 (97.0)	158 (96.9)	

Variable	Navigator	Intervention group (n = 305)	Usual Care group (n = 163)	P Value ^d
Insurance Type, ^c n, (%)				
Medicare	183 (60.0)	104 (63.8)	.481	
Medicaid	178 (48.4)	81 (49.7)	.072	
Private or supplemental	87 (28.5)	47 (28.8)	.944	
Primary language, n, (%)			<.001	
English	171 (56.1)	122 (74.8)		
Spanish	124 (40.7)	41 (25.2)		
Other (French/Creole/Arabic/Russian)	10 (3.3)	0 (0.0)		
Has own eye doctor (access to eye care), n, (%)			.526	
No	209 (68.5)	107 (65.6)		
Yes	96 (31.5)	56 (34.4)		
Wears prescription eyeglasses, n, (%)			.681	
No	77 (25.2)	44 (27.0)		
Yes	228 (74.8)	119 (73.0)		
Attended initial in-office eye exam			.004 ^e	
Yes	158 (51.8)	62 (38.1)		
No	147 (48.2)	101 (61.9)		

SD = standard deviation.

^aBold *P* value indicates statistical significance at the $P \leq .05$ level.^bHispanic (n = 297) + Multiethnic (n = 17).^cFor types of insurance variables, the levels were not mutually exclusive, so that the sum of the values may exceed 220 participants.^dFisher's exact test, all other tests use Pearson chi-squared test.^et-test.

TABLE 2.
NYC-SIGHT: Demographics and Social Determinants of Health for Participants Referred for Initial In-Office Eye Exam by Adherence

Variable	Attended initial in-office eye exam (n = 220) ^c	Did not attend initial in-office eye exam (n = 248) ^c	P Value ^a
Randomization group Navigator Intervention group, n, (%)	158 (51.8)	147 (48.2)	.004
Usual Care group, n, (%)	62 (38.1)	101 (61.9)	
Age, mean (±SD)	70.2 (11.3)	69.9 (11.6)	.812
Age category, n, (%)			.792
40–59 years	40 (18.2)	49 (19.8)	
60–79 years	134 (60.9)	153 (61.7)	
≥80 years	46 (20.9)	46 (18.5)	
Sex, n, (%)			.624
Male	76 (34.5)	80 (32.3)	
Female	144 (65.5)	168 (67.7)	
Race/ethnicity, n, (%) ^b			.003
African American	103 (46.8)	155 (62.5)	
Hispanic	104 (47.3)	81 (32.7)	
Others	13 (5.9)	12 (4.8)	
Education level, n, (%)			.865
Less than high school	67 (30.5)	71 (28.6)	
High school	75 (34.1)	83 (33.5)	
Some college, college graduate, or graduate degree	78 (35.5)	94 (37.9)	
Employment Status, n, (%)			.803
Employed (full-time/part-time)	34 (15.5)	47 (19.0)	
Unemployed	22 (10.0)	24 (9.7)	
Retired	139 (63.2)	151 (60.9)	
Disabled/unable to work	25 (11.4)	26 (10.5)	
Marital status, n, (%)			1.000
Single, divorced, separated, or widowed	168 (76.4)	189 (76.2)	
Married/domestic partner	52 (23.6)	59 (23.8)	
Has health insurance, n, (%)			.052
No	3 (1.4)	11 (4.4)	
Yes	217 (98.6)	237 (95.6)	

Variable	Attended initial in-office eye exam (n = 220) ^c	Did not attend initial in-office eye exam (n = 248) ^c	P Value ^d
Insurance Type ^c , n, (%)			
Medicare	133 (60.5)	154 (62.1)	.716
Medicaid	140 (63.6)	119 (48.0)	<.001
Private or supplemental	61 (27.7)	73 (29.4)	.683
Primary language, n, (%)			<.001
English	116 (52.7)	177 (71.4)	
Spanish	96 (43.6)	69 (27.8)	
Other (French/Creole/Arabic/Russian)	8 (3.6)	2 (.8)	
Has own eye doctor (access to eye care), n, (%)	66 (30.0)	86 (34.7)	.281
Wears prescription eyeglasses, n, (%)	163 (74.1)	184 (74.2)	.980

SD = standard deviation.

^d **Bold** *P* value indicates statistical significance at the *P* ≤ .05 level.

^b Hispanic (n = 297) + Multiethnic (n = 17).

^c For types of insurance variables, the levels were not mutually exclusive, so that the sum of the values may exceed 220 participants.

TABLE 3.
NYC-SIGHT: Medical and Ocular History, and Eye Health Screenings for Participants Referred for Initial In-Office Eye Exam by Adherence

Variable	Attended initial in-office eye exam (n = 220)	Did not attend initial in-office eye exam (n = 248)	p Value ^a
Last dilated eye exam, n, (%)			.435
Within the past year	59 (26.8)	67 (27.0)	
Within 1 to 2 years	56 (25.5)	69 (27.8)	
More than 2 years	88 (40.0)	90 (36.3)	
Can't remember	1 (0.5)	6 (2.4)	
Never had eye exam	16 (7.3)	16 (6.5)	
Medical conditions, n, (%)			
Hypertension	149 (67.7)	158 (63.7)	.361
Diabetes	69 (31.4)	82 (33.1)	.694
Ocular conditions, n, (%) ^b			
Dry eye	106 (48.2)	112 (45.2)	.513
Blurry vision	85 (38.6)	90 (36.3)	.601
Cataract	69 (31.4)	79 (31.9)	.909
Glaucoma	42 (19.1)	29 (11.7)	.026
Floaters	28 (12.7)	44 (17.7)	.133
Double vision	13 (5.9)	14 (5.6)	.903
Diabetic retinopathy	5 (2.3)	4 (1.6)	.740 ^d
Macular degeneration	5 (2.3)	2 (.8)	.262 ^d
No ocular conditions	36 (16.4)	58 (23.4)	.058
Family History, n, (%)			
Family history of glaucoma	47 (21.4)	66 (26.6)	.185
Family history of blindness	18 (8.2)	29 (11.7)	.207
Visual acuity based on worse eye, n, (%) ^b			.095
No vision impairment: logMAR ^c 0–0.2	39 (17.7)	55 (22.2)	
Mild vision impairment: logMAR ^c 0.3–0.4	68 (30.9)	74 (29.8)	
Moderate vision impairment: logMAR ^c 0.5–0.7	64 (29.1)	84 (33.9)	
Severe vision impairment: logMAR ^c 1.0–3.0	49 (22.3)	35 (14.1)	

Variable	Attended initial in-office eye exam (n = 220)	Did not attend initial in-office eye exam (n = 248)	P Value ^a
IOP (mmHg), mean (SD)			
Left eye (n = 706)	15.31 (5.10)	14.69 (4.31)	.157
Right eye (n = 705)	15.59 (5.33)	14.60 (4.30)	.029
Failed screening, n, (%)	190 (86.4)	216 (87.1)	.815
Reason for screening failure, n, (%)			
Visual acuity 20/40 or worse in either eye	181 (82.3)	193 (77.8)	.230
IOP 23–29 mmHg	25 (11.4)	19 (7.7)	.171
Unreadable image	47 (21.4)	70 (28.2)	.087

IOP = intraocular pressure; logMAR = logarithm of the minimum angle of resolution; SD = standard deviation.

^a**Bold P**Value indicates statistical significance at the $P \leq .05$ level.

^bFor self-reported ocular conditions, the levels were not mutually exclusive, so that the sum of the values may exceed 220 or 24.

^clogMAR converted from Snellen eye chart visual acuity participants.

^dRefers to Fisher's Exact Test, all other tests use the Pearson Chi-square.

TABLE 4.
NYC-SIGHT: Multivariate Stepwise^b Logistic Regression Model Estimating Factors Associated with Adherence to Initial In-Office Eye Exam for Participants Referred to Ophthalmology.

Variables	OR	95% CI	P Value ^a
Randomization group			
Usual Care group	1		
Navigator Intervention group	1.529	(1.023, 2.285)	0.038
Language			
Non-English	1		
English	1.815	(1.211, 2.721)	0.004
Health insurance type			
No Medicaid	1		
Medicaid	0.636	(0.430, 0.941)	0.023
Self-reported glaucoma or glaucoma suspect			
No	1		
Yes	0.585	(0.345, 0.994)	0.047

IOP = intraocular pressure.

^a Bold P Value indicates statistical significance at the $P \leq .05$ level.

^b At each step, variables were added based on the alpha-to-enter significance level of 0.05 and the alpha-to-remove significance level was set at 0.1 to exclude variables in the final model.