HHS Public Access

Author manuscript

J Glaucoma. Author manuscript; available in PMC 2025 January 07.

Published in final edited form as:

J Glaucoma. 2021 October 01; 30(10): 875–877. doi:10.1097/IJG.0000000000001920.

Lessons Learned from Two Large Community-Based Glaucoma Screening Studies

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Abstract

Community-based screening programs have had limited success in preventing vision loss from glaucoma due to overall low prevalence of glaucoma, screening limitations, and barriers to follow-up appointments. This editorial highlights lessons learned from two large prospective trials: the Philadelphia Telemedicine Glaucoma Detection and Follow-up Study (PTGDFS) and the Screening To Prevent Glaucoma Study (SToPGS). While some lessons are specific to ophthalmology, many lessons are applicable to screening for asymptomatic diseases in underserved, vulnerable communities.

Glaucoma, the second leading cause of blindness worldwide,[1] affects approximately 3 million Americans, but at least half remain undiagnosed due to a multitude of barriers.[1,2] Community-based screening programs have had limited success in preventing vision loss from glaucoma due to overall low prevalence of glaucoma, screening limitations, and barriers to follow-up eye care.

Wills Eye Hospital/Thomas Jefferson University and Johns Hopkins/Wilmer Eye Institute conducted two prospective trials to evaluate clinical models to screen those at high risk for glaucoma and other eye diseases in an urban setting: the Philadelphia Telemedicine Glaucoma Detection and Follow-up Study (PTGDFS) and the Screening To Prevent Glaucoma Study (SToPGS) in Baltimore. These large-scale public health studies offer many

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lessons, and demonstrate models for low-cost, high-impact interventions to reduce vision loss in underserved, vulnerable populations.

Lessons Learned Specific to Vision Screening:

1. Screening comprised of visual acuity, non-mydriatic fundus photography, rebound tonometry, and a limited history and was able to detect glaucoma and other eye diseases in targeted populations at high risk for glaucoma and vision loss. Methodology and design details are outlined in prior manuscripts (Zhao et al. AJO 2017 and Hark et al. AJO 2017).
    a. The targeted high-risk population in the SToPGS included: African-American individuals ≥ 50 years of age were recruited in the SToPGS. Screenings of the first 901 participants found glaucoma (8.7%), cataracts (6.8%), diabetic retinopathy (1.1%), age-related macular degeneration (0.3%), and uncorrected refractive error (11.9%).[3]
    b. The targeted high-risk population in the PTGDFS included: African-American, Hispanic/Latino, or Asian individuals >40 years old, white individuals >65 years old, and anyone >40 years old with a family history of glaucoma or diabetes. Screening outcomes of the 906 screened participants included suspicious optic nerve appearance (28.5%), ocular hypertension (6.8%), diabetic retinopathy (11.3%), and other retinal abnormalities (7.5%).[4]
    c. Notably these studies were not designed to specifically identify other types of glaucoma such as pseudoexfoliation.
2. Vision screenings and community-based eye examinations can be done at relatively low cost.
    a. The mean total time to complete each vision screening visit was 22.7 minutes, at a recurring cost of $7.78 in PTGDFS.[5] The total cost for each participant who completed both a vision screening and confirmatory eye examination and was diagnosed with an ocular condition was $64.44 in PTGDFS.[5] These costs exclude space shared by the local health centers as well as the more limited equipment costs associated with screening examinations as opposed to comprehensive ophthalmic testing.
    b. If most participants are insured, institutions engaged in vision screening have the potential to capture revenue when conducting subsequent definitive examinations and surgeries for those that screen positive, reducing financial barriers to conducting screenings. The majority (93%) of screened participants from these two underserved settings were insured despite having low income levels (45% of participants in the SToP Glaucoma study had annual income <$10,000).[3] This highlights the complex barriers to healthcare utilization, even after barriers to obtaining insurance are surpassed.

3. Unreadable fundus images captured during community-based vision screenings warrant referral for a complete eye examination, as rates of ocular pathology were high in this group.
    a. A total of 65% of those with unreadable images were eventually diagnosed with at least one eye condition in the PTGDFS (most frequently cataracts, followed by glaucoma suspects and narrow angles).[6]
    b. Participants with ungradable images in the SToPGS were less likely to have glaucoma but had similar prevalence of eye conditions compared to those referred for other reasons.[3]
4. The value of measuring intraocular pressure (IOP) during glaucoma screening is uncertain; optic nerve examination is more likely to detect glaucoma. That said, identifying participants with very high IOP can identify those at high risk for glaucoma.
    a. In the PTGDFS, 1.7% of those screened had IOP >30 mmHg in at least one eye and were placed in the Fast Track protocol for treatment.[7]
    b. 18% of participants had IOP 22–29 mmHg in at least one eye.[7] In the SToPGS, 13% of participants had IOP >22 mmHg.
    c. Seven percent of participants were referred for follow-up eye examination based solely on IOP >21 mmHg or IOP > 22mH in at least one eye in the PTGDFS[7] and SToPGS study[3], respectively.
        i. However, an initial IOP >21 mmHg in PTGDFS, without suspicious optic nerves, did not significantly increase the odds of being diagnosed with glaucoma at the follow-up eye examination (OR 1.17, 95% CI 0.29–4.16).
        ii. On the other hand, having an IOP >21 mmHg was associated with increased odds of being diagnosed with glaucoma in participants who also had suspicious nerves on fundus photography [OR 4.48, 95% CI, 1.50–13.93;P=0.007].
5. Screening for vision-threatening diseases carries more impact compared to screening for glaucoma alone.
    a. These underserved populations had high rates of ocular pathology; 40% of participants in SToPGS and 60% in PTGDFS failed the vision screening.[3, 4]
    b. Screening for reduced visual acuity identified cataracts. Given that the at risk population was mostly insured, identifying and operating on visually significant cataracts can not only improve quality of life, but also offset costs of the screening itself.
    c. Of the participants that completed a follow-up eye examination by an ophthalmologist in PTGDFS, 77% were diagnosed with cataracts,

of which 14% had visually significant cataracts.[8] Similarly 40% of participants referred for a definitive eye examination in the SToPGS had visually significant cataracts, of which 36% had subsequent cataract surgery in at least one eye.[3]

d. Signficant retinal disease and uncorrected refractive error can be identified without additional cost or equipment.

i. SToPGS identified diabetic retinopathy (1.1%), age-related macular degeneration (0.3%), and uncorrected refractive error (11.9%).[3]

ii. PTGDFS identified diabetic retinopathy (11.3%), and other retinal abnormalities (7.5%).[4]

iii. The disparity in the frequency of identification of other common pathologies amongst these studies highlights the importance of choosing methodology that fits screening goals. PTGDFS had greater rate of diabetic retinopathy likely related to higher rate of diabetes (58.7%) and inclusion of anyone >40 years old with a family history of glaucoma or diabetes. On the other hand, SToPGS identified significant refractive error due to methodology that specifically used an autorefractor when best-corrected visual acuity was worse than 20/40 and mailed prescription glasses to those that only screened positive for refractive error.

6. Screening without gonioscopy still allows many glaucoma suspects with narrow angles to be identified on follow-up complete eye examinations.

a. Gonioscopy can identify angle closure but is currently impractical in a vision screening protocol; it is recommended for those who fail screening.

b. Narrow angles were seen at higher rates than anticipated on confirmatory eye examinations in PTGDFS. Thirty-two participants (3.5%) were diagnosed with anatomically narrow angles during confirmatory examination that was recommended due to either solely IOP >21 mmHg or unreadable images. [6, 7] Untreated, these participants are at risk for acute or chronic angle closure glaucoma.

c. The Zhongshan Angle Closure Prevention (ZAP) trial[9] suggests that narrow angles in the absence of other findings are unlikely to lead to substantial vision loss in 6 years in the vast majority of cases in a Chinese population; however it is unclear whether this remains true past 6 years or in other ethnicities.

Broader Lessons Learned:

1. *Collaborate:* Primary care offices and Federally Qualified Health Centers offer an opportunity to conduct vision screenings in at-risk populations.
2. *Engage race- and language-concordant staff:* This can help build trust; language concordance has practical implications during and after screenings, especially in communities with older non-English speaking participants. Patient navigator race and language concordance may improve timeliness of care in a minority population, based on a study of cancer follow-up after abnormal screening results.[10]
3. *Make it easy to participate:* Anticipate and encourage walk-ins and same-day appointments when possible.
    a. Despite letters and phone calls, only a small portion (<10%) who would have qualified for a screening in the PTGDFS actually scheduled a screening visit. Of those individuals, more than 30% did not show up for their vision screening appointments.
    b. Participants who were considered ‘walk-ins’ eventually comprised 40% of screening participants, and had higher rates of ocular findings compared to those who had a scheduled screening appointment.[4]
4. *Focus on improving adherence to follow-up eye examinations*:
    a. Shorter distance between the vision screening and follow-up site was associated with greater adherence to confirmatory eye examination in SToPGS.[11]
    b. Participants with vision impairment and/or abnormal macula on ocular photography were more likely to return for a follow-up examination in SToPGS.[11] This highlights the importance of educational interventions to improve awareness of the gravity of asymptomatic eye diseases.
    c. Several strategies were employed during the second phase of SToPGS that contributed to significantly improved follow-up: pre-scheduled follow-up appointments soon after the screening, educational videos, multiple reminder calls, and the use of vouchers that stated the value of the examination. Despite this, 43% of invited participants did not return for a follow-up eye examination in SToPGS.
    d. The PTGDF found that patient navigators and social workers improved timely attendance at the first followup after the confirmatory eye examination (74.4% vs. 39.0%; aRR=1.85; 95% CI 1.51–2.28; P<.001; data not published) [12,13]

These two studies identified successful strategies to affordably and effectively screen for treatable eye disease in vulnerable, underserved populations in urban settings. Despite this progress, substantial challenges remain to reduce the burden of vision-threatening conditions in these at-risk populations.

Acknowledgments and Funding Disclosure:

This work was supported by the United States Centers for Disease Control and Prevention (CDC) Vision Health Initiative grants: U01DP005123 and U01DP005127.

Disclosures:

NNK: Research support from Aerie, Allergan, Diopsys, Guardion Health Services Inc, Glaukos, Equinox, Nicox, Olleyes, Santen. Consultant (spouse): Allergan, Regeneron, Alimera, Genentech

LJK: Grant/Research Support: Heidelberg Engineering, Zeiss; Consultant/Advisory Board: Allergan, Bausch and Lomb; Speakers List: Allergan, Glaukos, Bausch and Lomb; Stock Shareholder: Glaukos, Mati Therapeutics, Aerie, Olleyes; Employment: Glaukos (Chief Medical Officer)

LAH: Funded by the Centers for Disease Control and Prevention Vision Health Initiative for the Manhattan Vision Screening and Follow-up Study in Vulnerable Populations and the Coordinating Center for Community Based-Interventions with Vulnerable Populations.

JSM: Research support from Allergan, Equinox, Glaukos, Guardion Health Services Inc, Nicox, Olleyes, Santen. Consultant Aerie, Allergan, Gluakos, MicroOptix, Olleyes. DSF: Consultant: Gore, Clearview Health Partners, Bausch and Lomb, Thea Pharaceuticals

References:

1. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. The British journal of ophthalmology 2006;90:262–267. [PubMed: 16488940]
2. Friedman DS, Wolfs RC, O'Colmain BJ, et al. Prevalence of open-angle glaucoma among adults in the United States. Archives of ophthalmology 2004;122:532–538. [PubMed: 15078671]
3. Zhao D, Guallar E, Gajwani P, et al. Optimizing Glaucoma Screening in High-Risk Population: Design and 1-Year Findings of the Screening to Prevent (SToP) Glaucoma Study. American journal of ophthalmology 2017;180:18–28. [PubMed: 28549849]
4. Hark LA, Katz LJ, Myers JS, et al. Philadelphia Telemedicine Glaucoma Detection and Follow-up Study: Methods and Screening Results. American journal of ophthalmology 2017;181:114–124. [PubMed: 28673747]
5. Hark LA, Myers JS, Ines A, et al. Philadelphia Telemedicine Glaucoma Detection and Follow-up Study: confirmation between eye screening and comprehensive eye examination diagnoses. The British journal of ophthalmology 2019;103:1820–1826. [PubMed: 30770354]
6. Hark LA, Myers JS, Rahmatnejad K, et al. Philadelphia Telemedicine Glaucoma Detection and Follow-up Study: Analysis of Unreadable Fundus Images. Journal of glaucoma 2018;27:999–1008. [PubMed: 30180021]
7. Hark LA, Myers JS, Pasquale LR, et al. Philadelphia Telemedicine Glaucoma Detection and Follow-up Study: Intraocular Pressure Measurements Found in a Population at High Risk for Glaucoma. Journal of glaucoma 2019;28:294–301. [PubMed: 30946709]
8. Hark LA, Adeghate J, Katz LJ, et al. Philadelphia Telemedicine Glaucoma Detection and Follow-Up Study: Cataract Classifications Following Eye Screening. Telemedicine journal and e-health : the official journal of the American Telemedicine Association 2019.
9. He M, Jiang Y, Huang S, et al. Laser peripheral iridotomy for the prevention of angle closure: a single-centre, randomised controlled trial. Lancet 2019;393:1609–1618. [PubMed: 30878226]
10. Charlot M, Santana MC, Chen CA, et al. Impact of patient and navigator race and language concordance on care after cancer screening abnormalities. Cancer 2015;121:1477–1483. [PubMed: 25565151]
11. Zhao D, Guallar E, Bowie JV, et al. Improving Follow-up and Reducing Barriers for Eye Screenings in Communities: The SToP Glaucoma Study. American journal of ophthalmology 2018;188:19–28. [PubMed: 29355481]
12. Hark LA, Johnson DM, Berardi G, et al. A randomized, controlled trial to test the effectiveness of a glaucoma patient navigator to improve appointment adherence. Patient preference and adherence 2016;10:1739–1748. [PubMed: 27660423]

13. Hark LA, Radakrishnan A, Madhava M, et al. Awareness of ocular diagnosis, transportation means, and barriers to ophthalmology follow-up in the Philadelphia Telemedicine Glaucoma Detection and Follow-up Study. Social work health care 2019;58:651–664.