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Improving follow-up adherence in a primary eye care setting: a prospective, randomized controlled trial

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IMPROVING FOLLOW-UP ADHERENCE IN A PRIMARY EYE CARE

SETTING: A PROSPECTIVE, RANDOMIZED CONTROLLED TRIAL

by

CATHERINE E. CALLINAN

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Approved by

First Reader

        Karen Symes, Ph.D.
        Assistant Dean of Student Affairs
        Associate Professor of Biochemistry

Second Reader

        Lisa Hark, Ph.D., R.D.
        Director, Glaucoma Research Center and Department of
        Research

DEDICATION

I would like to dedicate this work to my family and friends for all of their support

throughout my journey to medical school.

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IMPROVING FOLLOW-UP ADHERENCE IN A PRIMARY EYE CARE SETTING: A PROSPECTIVE, RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Introduction

Lack of follow-up to recommended appointments can decrease vision outcomes. Research is needed to determine the best approach to scheduling follow-up appointments in the primary eye care setting to help overcome barriers and decrease disparities in vision health. The specific aim of this work is to evaluate the effectiveness of automated and personal telephone interventions to improve follow-up adherence in the primary eye care setting.

Methods

In a prospective, single-blind, randomized, controlled trial, 1,095 patients seen in the Cataract and Primary Care service (CPEC) at Wills Eye Hospital who were due for follow-up appointments were randomly assigned to usual care, automated telephone intervention or personal telephone intervention group. Patients in the usual care group (n=364) received a form letter reminding them to make an appointment and an automated reminder phone call one day prior to their scheduled visit.

Automated intervention participants (n=365) received the usual care form letter and an automated call 1-month prior to their recommended follow-up date,

a mailed appointment reminder if an appointment was scheduled, and an automated telephone reminder the day before the scheduled appointment. If a patient in the automated intervention group did not attend the scheduled appointment, a reminder postcard was sent.

Personal intervention participants (n=365) received the traditional form letter and a personal telephone call 1-month prior to the recommended follow-up date, a mailed appointment reminder if an appointment was scheduled, and a personal telephone reminder prior to the scheduled appointment. If a patient in the personal intervention group did not attend the scheduled appointment, they received a personal call. Scheduling and attendance data were extracted from the electronic medical record system.

Results

Patients in the personal intervention group had greater adherence to follow-up recommendations than patients in the usual care group (37.70% vs. 27.47%; RR: 1.37; CI 1.24-1.52; p<0.001) and automated intervention group (29.59%; RR: 1.27; CI 1.15-1.41; p=0.02). Patients in the usual care group were not significantly different than patients in the automated intervention group in regards to adherence to follow-up recommendations (27.47% vs. 29.59%; RR: 1.08; CI 0.98-1.18; p=0.53).

Personal intervention improved adherence for patients who have been previously recognized as at risk including men (37.04% vs. 22.39%; RR: 1.65; CI:

1.41-1.94; p=0.01), African Americans (39.58% vs. 29.52%; RR: 1.34; CI 1.16-1.55; p=0.03), patients under 65 (28.93%-18.67%; RR: 1.55; CI 1.40-1.71; p=0.01), and patients who live greater than 20 miles from Wills Eye Hospital (44.74% vs. 12.50%; RR: 3.58; CI 2.59-4.95; p=0.01). Additionally, personal intervention improved adherence in patients with Medicare (58.42% vs. 43.56%; RR: 1.34; CI 1.01-1.79; p=0.03) and urban patients who live within 2 miles of Wills Eye Hospital (41.18% vs. 17.54%; RR: 2.35; CI 1.81-3.04; p=0.01).

As a secondary endpoint, personal intervention significantly improved appointment scheduling over usual care (51.09% vs. 32.14%; RR 1.59; 95% CI 1.33-1.90; p<0.001) and automated intervention (51% vs. 36%; RR: 1.40; CI 1.18-1.66; p<0.001). Automated intervention did not significantly improve appointment scheduling over usual care (36% vs. 32%; RR: 1.13; CI 0.93-1.39; p=0.22).

Conclusion

Personal intervention improved adherence to recommended follow-up for primary eye care appointments overall and in at-risk populations. Automated intervention had no significant improvement over usual care. The cost effectiveness of personal intervention to improve outcomes in a primary ophthalmology setting should be evaluated to determine whether the intervention should be implemented as a process change at Wills Eye Hospital and at other primary ophthalmology care centers.

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LIST OF ABBREVIATIONS

CDC .... Centers for Disease Control and Prevention

CI .... Confidence interval (95%)

CPEC .... Cataract and Primary Care service

CSME .... Clinically significant macular edema

DFE .... Dilated fundus examinations

ECP .... Eye care provider

EMR .... Electronic medical record

IRB .... Institutional Review Board

NPDR .... Non-proliferative diabetic retinopathy

PDR .... Proliferative diabetic retinopathy

RR .... Relative risk

SD .... Standard deviation

INTRODUCTION

Importance of vision health

Vision health is critical to the overall health of the individual and has a significant impact on quality of life (Qui, Wang, Singh, & Lin, 2014). Low vision and blindness decrease an individual's ability to walk, read, and drive. They can increase rates of depression, risk of falls and other injuries, social isolation, loss of productivity, and premature death (Zhang et al., 2012).

It has been suggested that from 1990 to 2010 the global burden of vision loss increased by 47% (Murray et al., 2013). Among US adults, visual impairment ranks among the top 10 disabilities (Chou et al., 2012), and more than 28 million adults in the US suffer from an age-related eye disease, a number that could increase by 50% or more by 2020 (Elam & Lee, 2013). Vision disorders in Americans 40 years and older cost the government $35.4 billion per year in addition to costing individuals, caregivers, and non-government health care payers an estimated $16 billion per year (Li, Xirasagar, Pumkam, Krishnaswamy, & Bennett, 2013).

It has been suggested that up to 50% of cases of blindness or visual impairment are preventable by early detection and treatment (Chou et al., 2012). Prior year eye care was associated with better vision in patients with and without significant ophthalmic disease (Li, Xirasagar, Pumkam, Krishnaswamy, & Bennett, 2013). The American Academy of Ophthalmology recommends that eye examinations for people age 40-54 years without risk factors every 2-4

years, age 55-64 without risk factors every 1-3 years, and age 65 and older without risk factors every 1-2 years. For those with risk factors, eye examinations are recommended even more frequently. (Elam & Lee, 2013)

One of the most significant risk factors for visual impairment is diabetes mellitus, which can cause diabetic retinopathy. People with type 2 diabetes are recommended to have an eye examination yearly after their initial diagnosis. People with type 1 diabetes are recommended to have an eye examination yearly beginning 5 years after diagnosis. Table 1 shows the specific recommendations for follow-up based on severity of the diabetic retinopathy. Diabetic retinopathy in its early stages requires less frequent follow-up especially when there is no presence of clinically significant macular edema. When the non-proliferative diabetic retinopathy starts to become severe or proliferative, more frequent follow-up is recommended. (American Academy of Ophthalmology, 2013)

Table 1: Vision care follow-up recommendations for patients with diabetes (American Academy of Ophthalmology, 2013)

Severity of Retinopathy	Presence of CSME*	Follow-up (months)
Normal or minimal NPDR	No	12
Mild to moderate NPDR	No	6-12
	Yes	2-4
Severe NPDR	No	2-4
	Yes	2-4
Non-high-risk PDR	No	2-4
	Yes	2-4
High-risk PDR	No	2-4
	Yes	2-4
Inactive/involuted PDR	No	6-12
	Yes	2-4

CSME = clinically significant macular edema; NPDR = nonproliferative diabetic retinopathy; PDR = proliferative diabetic retinopathy

Despite these recommendations, most people with diabetes do not receive optimal eye care (Chou et al., 2014). Promotion of vision health requires adequate primary ophthalmologic care, but barriers to vision care and health disparities often preclude adequate care.

Barriers in vision health

Increasing age, being a racial/ethnic minority, diagnosis with diabetes mellitus, and low socioeconomic status are shown to be high risk factors for eye disease (Elam & Lee, 2013). The population of older Americans is increasing as is the population of minority racial and ethnic groups who are more likely to have visual impairment and eye disease than non-minorities (Chou et al., 2012). In

addition to their greater risk of disease, some studies report limited access to eye care services for racial and ethnic minorities (Murakami et al., 2011; Elam & Lee, 2013). Other studies report no impact of race on use (Kosoko et al., 2010) or mixed usage by age group (Wagner & Rein, 2013).

In addition to racial minorities, studies report also less usage of eye care services and adherence to recommendations by younger peoples. In a study of health disparities in patients with glaucoma, Gwira et al. found that older people were were more likely to see an ophthalmologist and be compliant with follow-up appointments (2006). Likewise, a study by Perron et al. found that younger age, male gender, follow-up appointment greater than one year, and substance abuse all correlated to lower rates of appointment adherence (2010). Other studies have also determined that men tend to make less use of vision health services (Elam & Lee, 2013; Wagner & Rein, 2013). Wagner & Rein also found that women, whites, and older age groups made greater use of eye care services (2013). These consistent findings across a number of studies strongly suggest that real disparities exist by ethnicity, age, and gender.

A number of studies report that lack of health and vision insurance is a significant barrier to vision care (Elam & Lee, 2013; Li, Xirasagar, Pumkam, Krishnaswamy, & Bennett, 2013; Paksin-Hall, Dent, Dong, & Ablah, 2013; Wagner & Rein, 2013). A recent study in working-age adults found that 40% did not have vision insurance. Those who had vision insurance were significantly more likely than those without vision insurance to attend eye care visits.

Respondents with and without eye disease who had vision care reported higher quality of life. (Li et. al., 2013) In a study of people with diabetes, Paksin-Hall et al. found that insurance status significantly impacted the likelihood of receiving annual dilated eye examinations (2013).

Other barriers include income level, socioeconomic status and education level. In a study by Wagner & Rein, come greater than $35,000 was associated with greater eye care use, while lower education level was associated with less use of services (2013). Similarly, Elam & Lee found that socioeconomic status is strongly correlated with lower rates of health care utilization (2013).

Access to care is a noteworthy barrier to vision health services. Communities with larger proportions of minorities are more likely to have a shortage of physicians. Residents of these communities are more likely to have to travel outside of their neighborhood to be seen by a physician than residents of communities with larger percentages of non-minorities (Elam & Lee, 2013). Similarly, Owsley et al. found that accessibility to the doctor's office was the most common barrier to receiving regular eye care cited by older African Americans. The lack of accessibility was due to inadequate transportation resources, consistent with other findings in the elderly population. (Owsley et al., 2006) Chou et al. examined diabetic adults' access to eye care based on geographic density of eye care professionals (ECPs). Insured people with diabetes who lived in a county with a low density of ECPs were less likely to receive an annual

dilated eye examination (Chou et al., 2012). Without access to transportation or local ECPs, at-risk patients do not receive the care they need.

Communication between patient and physician is another notable barrier to eye care utilization. Communication of and education about a patient's diagnosis has been found to be an important factor for use of care by a number of studies (Elam & Lee, 2013; Kosoko et al., 2010; Murakami et al., 2011; Wagner & Rein, 2013). The studies found that if patients fully understand their diagnosis and the risks of not adhering to medication or recommended eye care visits, they are more likely to adhere to both medications and appointments with their ECP.

The relationship between patient and physician impacts use of eye care services as well. Cultural barriers including belief system, trust issues, education level, language, concordance between physician and patient, health literacy, and immigration status can all contribute to lower use of eye care (Elam & Lee, 2013).

Many studies have explored the barriers to ophthalmic care and disparities in vision health, but few very studies have examined how to improve rates of medication and appointment adherence.

Adherence studies

Interventions are needed to overcome barriers to vision care to improve patient adherence to physician recommendations. A quantitative review conducted by DiMatteo of 50 years of research examined variations in patient

adherence to medical recommendations. The study suggests that patients with high adherence have 26% better health outcomes than patients with low adherence. (DiMatteo, 2004) The dependence of healthcare costs and health outcomes on adherence to physician recommendations renders adherence a significant issue requiring more intervention.

System-level research has the potential to improve care by encouraging greater appointment scheduling and adherence. Studies of adherence have been conducted in various fields of medicine. Henry et al. piloted an automated telephone intervention system to reduce the number of appointment no-shows at HIV primary clinics. While the intervention was successful for patients who were not diagnosed with depression, who were not homeless, and who had more frequent appointments scheduled, the intervention was not successful for patients who were homeless, racial/ethnic minorities, or patients with mental health disorders. (Henry, Goetz, & Asch, 2012) This study has important implications for future studies of automated intervention as the intervention was unsuccessful for specific at-risk subpopulations. It is important to examine the intervention's impact on the most vulnerable, at-risk populations.

Biese et al. examined how personal telephone intervention impacted follow-up with a primary care physician after a visit to the emergency department. The telephone intervention group was significantly more likely to follow-up with their primary care physician when contacted personally via telephone compared to those who were not contacted (Biese et al., 2014). The study was conducted

in an older population, and thus the results may not translate for younger individuals, or to other primary care settings.

Studies of telephone intervention have shown promise in improving health outcomes in various fields of ophthalmology. Most studies have been in patients with glaucoma and patients with diabetes mellitus likely due to the severity and prevalence of these diseases. An automated, interactive telephone-based health communication intervention was piloted to improve glaucoma treatment adherence in a study by Glanz et al. (2012). The study demonstrated the severity of glaucoma patient non-adherence to medication and appointments. The telephone-based intervention system improved patient treatment and appointment adherence (Glanz et al., 2012).

A similar intervention study used multiple monthly automated phone calls, an education session, and an appointment with a physician to remind patients with glaucoma to take their medication. However, this automated intervention did not have a significant impact on adherence. Poor adherence was associated with depression and hypochondriasis. (Lim, Watnik, Imson, Porter, & Granier, 2013) Despite these findings, Kowing et al. reports that provider and patient reminder and recall systems are currently used by ophthalmology and other specialty clinics to improve both medication and appointment adherence. Automated systems are currently employed, offering patients the option to confirm or reschedule appointments. (Kowing et al., 2010)

Educational and print interventions have been piloted to increase the rates of diabetic fundus examinations (DFEs) without success (Owsley et al., 2013; Ellish, Royak-Schaler, & Higginbotham, 2011). However, personal phone calls improved rates of return to DFEs in patients over usual care (a letter mailed one month prior to recommended appointment) (Anderson et al., 2003). The study hypothesized that the personalization of the call improved the rates of return. In low-income African Americans with diabetes, telephone interventions increased rates of DFEs (Basch, Walker, Howard, Shamoon, & Zybert, 1999; Walker et al., 2008).

Telephone intervention showed 74% increase in probability of a screening compared with standard print reminders in a study of the urban poor. The study found that the intervention was successful in both English and Spanish-speakers and in both men and women (Walker et al., 2008). Intervention studies in glaucoma and diabetes have shown promise in improving screening, medication adherence, and appointment adherence.

However, there are mixed recommendations about the optimal design for adherence intervention systems. While some studies recommend multiple interventions (Halbert, Leung, Nichol, & Legorreta, 1999), other studies suggest that interventions that are simple yet personalized have been shown to be the most successful (Kosoko et al., 2010). According to a systematic review conducted by Vervloet et al., interventions involving personal reminders, such as telephone calls, had a positive impact on appointment and medication

adherence, but required a great amount of time and resources. The study determined electronic reminders tended to save more time and improved medication adherence. (Vervloet et al., 2012)

Rationale and specific aims

To date, there has not been a study in primary eye-care setting examining the best method to contact patients regarding appointment scheduling to improve patient adherence to follow-up recommendations. The objective of this study was to reduce the gap between recommended and actual follow-up adherence in the primary eye-care setting.

Utilizing information from electronic medical records (EMRs), a prospective, randomized, control trial was conducted in 1,095 patients to analyze the impact of automated and personal telephone-based interventions on patient adherence compared with usual care. The study analyzed eye care usage trends and the intervention success based on various patient demographics collected using the EMR system. The study outcomes will allow for recommendations at Wills Eye Hospital's Cataract and Primary Care Service and other primary eye-care settings regarding the best approach to follow-up process improvement.

METHODS

Ethical Approval

The study was approved by the Institutional Review Board (IRB) according to the tenets of the Declaration of Helsinki. Informed consent was waived by the IRB. This trial was registered at ClinicalTrials.gov (NCT02001129).

Trial Design

The study was a single-blinded, randomized controlled trial.

Participants

Eligible patients attended Wills Eye Hospital Cataract and Primary Care Service (CPEC) between September 1, 2012 and May 31, 2013, were 18 or older, and could both understand and speak English. Between September 1, 2013 and November 30, 2013, patients who were due for 6-month, 1-year, or 2-year follow-up appointments at the Wills Eye Hospital CPEC Service were enrolled in the study. Patients with medical or ocular conditions that required follow-up earlier than 6 months were excluded.

Randomization

Electronic medical records were employed to determine eligible subjects. Subjects were randomized to usual care, automated intervention, or personal intervention. Figure 1 depicts the study protocol in the form of a flow chart.
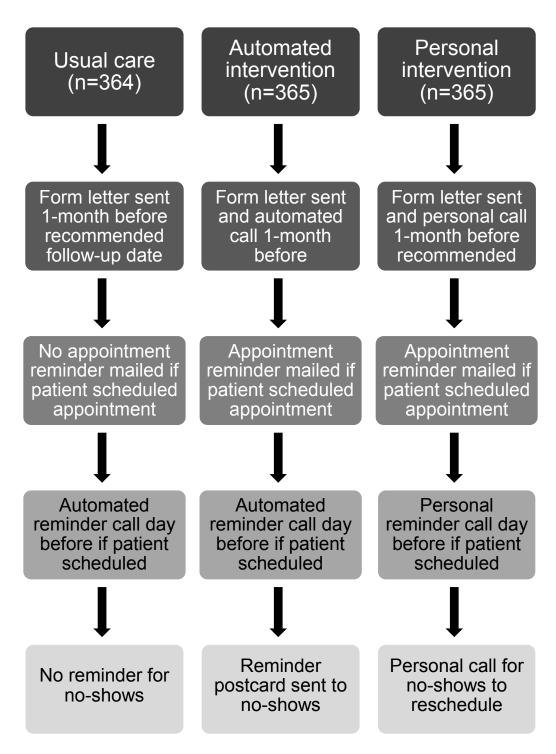
Figure 1: Usual care vs. intervention groups

Intervention

Patients assigned to the usual care group (n=364) received a brief, form letter, reminding them to make an appointment 1-month prior to the recommended follow-up date. Patients received no active assistance in scheduling appointments. Patients who made appointments received automated reminder calls the day before their scheduled appointments.

Patients in the automated intervention group (n=365) received the standard form letter and an automated telephone call one month prior to the recommended follow-up date encouraging them to schedule an appointment. If the patient scheduled an eye examination appointment, an appointment reminder was mailed, and the patient received an automated telephone reminder prior to the scheduled appointment. If the patient did not attend the scheduled appointment, a reminder postcard was sent.

Patients in the personal intervention group (n=365) received the standard form letter and one or two personal phone calls to offer assistance with making an appointment. Explanations for declined appointments were noted in FileMaker Pro, a research tracking software database (FileMaker, Inc.). Patients who scheduled appointments received an appointment reminder letter and a personal telephone reminder prior to the scheduled appointment. Patients who did not attend their appointment were contacted up to three times to assist them with scheduling.

The EMR was utilized to confirm scheduled appointments and assess patient adherence to keeping appointments.

Main Outcome Measures

The primary outcome measure was adherence to a follow-up vision care appointment in CPEC at Wills Eye Hospital. Adherence was defined as attendance at a recommended follow-up appointment. A patient was adherent if they scheduled and attended their appointment. Appointment scheduling was a secondary outcome, obtained from the EMR.

Statistical Analysis

The following data were obtained from the EMR at baseline: gender, ethnicity, age, home zip code, and insurance. The patients' home zip code was used to calculate their approximate distance from Wills Eye Hospital. Scheduling and attendance data were also extracted from the EMR after completion of the follow-up period.

Frequency counts with percentages were tabulated for categorical variables and means with standard deviations were calculated for continuous variables. Patient appointment scheduling and adherence rates in the automated intervention group and personal intervention group were compared with those who received the usual care. A chi-square test was conducted to compare the proportions of participants scheduling and adhering to their appointments.

Relative risks (RR) are presented with 95% confidence intervals (CI). A p value of 0.05 was considered significant.

RESULTS

Patient characteristics

From September to November 2013, 1095 patients were due for follow up care and randomly assigned, 364 to the usual care group, 365 to the automated intervention, and 365 to the personal intervention group. Required time to follow-up appointment (6-months, 1-year, and 2-years) was stratified across the three groups. Patients in each group had similar demographics in regards to age, gender, and ethnicity. The majority of patients were less than 65 years old (66.12%), female (63.01%), and African American (53.97%). The majority of the patients were due for a 1-year follow-up appointment (89.32%). Private was the most commonly held insurance type (39.63%). The majority of patients lived in zip codes within 5 miles of Wills Eye Hospital (55.80%). Table 2 summarizes these patient characteristics.

Table 2: Summary of patients characteristics (n=1,095)

Characteristic	Overall (n=1095)	Usual care (n= 364)	Automated intervention (n= 365)	Personal intervention (n=365)
Age, mean ± SD	56.85 (16.23)	56.80 (16.14)	56.95 (15.86)	56.82 (16.72)
Age, n (%)				
< 65 years	724 (66.12)	241 (66.21)	241 (66.03)	242 (66.12)
≥ 65 years	371 (33.88)	123 (33.79)	124 (33.97)	124 (33.88)
Gender, n (%)				
Female	690 (63.01)	230 (63.19)	229 (62.74)	231 (63.11)
Male	405 (36.99)	134 (36.81)	136 (37.26)	135 (36.89)
Ethnicity, n (%)				
Caucasian	293 (26.76)	85 (23.35)	99 (27.12)	109 (29.78)
African American	591 (53.97)	210 (57.69)	189 (51.78)	192 (52.46)
Hispanic	46 (4.20)	19 (5.22)	21 (5.75)	6 (1.64)
Asian	22 (2.01)	6 (1.65)	7 (1.92)	9 (2.46)
Other	143 (13.06)	44 (12.09)	49 (13.42)	50 (13.66)
Recommended follow-up, n (%)				
6 months	51 (4.66)	16 (4.40)	17 (4.66)	18 (4.92)
1 year	978 (89.32)	326 (89.56)	326 (89.32)	326 (89.07)
2 year	66 (6.03)	22 (6.04)	22 (6.03)	22 (6.01)
Insurance status, n (%)				
Charity	7 (0.64)	0 (0.00)	6 (1.64)	1 (0.27)
Medicaid	188 (17.17)	64 (17.58)	64 (17.53)	60 (16.39)
Medicare	299 (27.31)	101 (27.75)	97 (26.58)	101 (27.60)
Self-pay	29 (2.65)	10 (2.75)	11 (3.01)	8 (2.19)
Private	434 (39.63)	135 (37.09)	147 (40.27)	152 (41.53)
Vision Plan	138 (12.60)	54 (14.84)	40 (10.96)	44 (12.02)
Distance to Wills Eye, n (%)				
0-2 miles	167 (15.25)	57 (15.66)	59 (16.16)	51 (13.93)
2-5 miles	444 (40.55)	149 (40.93)	147 (40.27)	148 (40.44)
5-20 miles	388 (35.43)	134 (36.81)	125 (34.25)	129 (35.25)
>20 miles	96 (8.77)	24 (6.59)	34 (9.32)	38 (10.38)

SD = standard deviation

Scheduling and adherence

Personal intervention significantly improved appointment scheduling over usual care (51.09% vs. 32.14%; RR 1.59; 95% CI 1.33-1.90; p<0.001) and automated intervention (51.09% vs. 36.44%; RR: 1.40; CI 1.18-1.66; p<0.001). Automated intervention did not significantly improve appointment scheduling over usual care (36.44% vs. 32.14%; RR: 1.13; CI 0.93-1.39; p=0.22).

Patients in the personal intervention group had greater adherence to follow-up recommendations than patients in the usual care group (37.70% vs. 27.47%; RR: 1.37; CI 1.24-1.52; p<0.001) and automated intervention group (29.59%; RR: 1.27; CI 1.15-1.41; p=0.02). Patients in the usual care group were not significantly different than patients in the automated intervention group with regards to adherence to follow-up recommendations (27.47% vs. 29.59%; RR: 1.08; CI 0.98-1.18; p=0.53). Table 3 displays these results.

Table 3: Overall appointment scheduling and adherence across the intervention groups

Characteristic	Scheduling			Adherence		
	RR	CI	P value	RR	CI	P value
Automated vs. usual	1.13	0.93-1.39	0.22	1.08	0.98-1.18	0.53
Personal vs. usual	1.59	1.33-1.90	<0.001	1.37	1.24-1.52	0.003
Personal vs. automated	1.40	1.18-1.66	<0.001	1.27	1.15-1.41	0.02

Age

Patients over age 65 were significantly more likely to schedule an appointment (56.60% vs. 31.35%; RR: 1.81; CI 1.57-2.08; p<0.001) and adhere to follow-up recommendations (49.60% vs. 22.38%; RR: 2.22; CI 1.99-2.47; p<0.001) than patients younger than 65. The results are shown in Table 4.

Table 4: Demographic impact on appointment scheduling and adherence

Characteristic	Scheduling			Adherence		
	RR	CI	P value	RR	CI	P value
Female vs. male	1.08	0.93-1.26	0.33	1.05	0.97-1.14	0.5927
Over vs. under 65	1.81	1.57-2.08	<0.001	2.22	1.99-2.47	<0.001
African American vs. Caucasian	1.31	1.09-1.58	0.003	1.07	0.98-1.18	0.15

Regardless of age, patients were more likely to schedule an appointment if they received personal intervention rather than usual care (under 65: 42.98% vs. 24.48%; RR: 1.76; CI 1.35-2.29; 65 and over: 66.94% vs. 47.15%; RR: 1.42; CI 1.13-1.78; p<0.001). Additionally, patients younger than 65 were more likely to schedule an appointment if they received the personal intervention rather than the automated intervention (42.98% vs. 26.56%; RR: 1.62; CI 1.25-2.09; p<0.001). The results are displayed in Table 5.

Patients younger than 65 were significantly more likely to adhere to follow-up recommendations if they received the personal intervention instead of the automated intervention (28.93% vs. 19.50%; RR: 1.48; CI 1.34-1.64; p=0.02) or usual care (28.93%-18.67%; RR: 1.55; CI 1.40-1.71; p=0.01), while for patients

older than age 65, there was no significant difference on follow-up adherence between the intervention groups. The results are displayed in Table 5.

Gender

Gender did not significantly impact rates of scheduling appointments (women: 41.01% vs. men: 38.02%; RR: 1.08; CI 0.93-1.26; p=0.33) or follow-up adherence (women: 30.62% vs. men: 32.17%; RR: 1.05; CI 0.97-1.14; p=0.59). However, there were significantly more women than men in the study (63.01% vs. 36.99%; p<0.001). The results can be seen in Table 4.

Both male and female patients who received personal intervention were more likely to schedule an appointment than those who received automated intervention (male: 53.33% vs. 34.56%; RR: 1.54; CI 1.17-2.04; p<0.001; female: 49.78% vs. 37.55%; RR: 1.33; CI 1.07-1.64; p=0.01) and those who receive usual care (male: 53.33% vs. 26.12%; RR: 2.04; CI 1.47-2.83; p<0.001; female: 49.78% vs. 35.65%; RR: 1.40; CI 1.12-1.73; p<0.001). The results are displayed in Table 5.

Male patients who received personal intervention were more likely to adhere to follow-up recommendations than those who received usual care (37.04% vs. 22.39%; RR: 1.65; CI: 1.41-1.94; p=0.01). There was no significant difference in adherence between female patients who received usual care and either intervention (automated: 27.95% vs. 30.43%; RR: 0.92; CI 0.82-1.03;

p=0.56; personal: 38.10% vs. 30.43%; RR: 1.25; CI: 1.10-1.43; p=0.08). Table 5 displays these results.

Race

African Americans were significantly more likely than Caucasians to schedule appointments (44.33% vs. 33.79%; RR: 1.31; CI 1.09-1.58; p<0.0013). However, ethnicity was not a significant factor in adherence to follow-up recommendations (33.50% vs. 28.67%; RR: 1.07; CI 0.98-1.18; p=0.15). Table 4 details these results.

For African Americans, personal intervention resulted in higher rates of scheduling and adherence than usual care (scheduling: 56.25% vs. 35.71%; RR: 1.58; CI 1.26-1.96; p<0.001; adherence: 39.58% vs. 29.52%; RR: 1.34; CI 1.16-1.55; p=0.03). Personal intervention also resulted in higher rates of scheduling than automated intervention (56.25% vs. 41.80%; RR: 1.35; CI 1.09-1.66; p<0.001). No significant difference in appointment scheduling or adherence was found across the three groups for Caucasians. These results are found in Table 5.

Table 5: Impact of different interventions on appointment scheduling and adherence by demographic information

Characteristic	Scheduling			Adherence		
	RR	CI	P value	RR	CI	P value
Age						
< 65 years						
Automated vs. usual	1.08	0.8-1.47	0.60	1.04	0.96-1.14	0.82
Personal vs. usual	1.76	1.35-2.29	<0.001	1.55	1.4-1.71	0.01
Personal vs. automated	1.62	1.25-2.09	<0.001	1.48	1.34-1.64	0.02
> 65 years						
Automated vs. usual	1.18	0.92-1.51	0.18	1.10	0.87-1.39	0.48
Personal vs. usual	1.42	1.13-1.78	<0.001	1.23	0.95-1.58	0.11
Personal vs. automated	1.20	0.98-1.47	0.07	1.11	0.86-1.45	0.37
Gender						
Female						
Automated vs. usual	1.05	0.83-1.34	0.67	0.92	0.82-1.03	0.56
Personal vs. usual	1.40	1.12-1.73	<0.001	1.25	1.1-1.43	0.08
Personal vs. automated	1.33	1.07-1.64	0.01	1.36	1.2-1.55	0.02
Male						
Automated vs. usual	1.32	0.92-1.91	0.13	1.45	1.25-1.67	0.07
Personal vs. usual	2.04	1.47-2.83	<0.001	1.65	1.41-1.94	0.01
Personal vs. automated	1.54	1.17-2.04	<0.001	1.14	0.96-1.36	0.42
Ethnicity						
Caucasian						
Automated vs. usual	1.07	0.68-1.69	0.76	0.97	0.81-1.16	0.90
Personal vs. usual	1.46	0.97-2.19	0.06	1.19	0.99-1.42	0.45
Personal vs. automated	1.36	0.94-1.98	0.10	1.22	1.03-1.46	0.35
African American						
Automated vs. usual	1.17	0.91-1.5	0.21	1.08	0.94-1.23	0.63
Personal vs. usual	1.58	1.26-1.96	<0.001	1.34	1.16-1.55	0.03
Personal vs. automated	1.35	1.09-1.66	<0.001	1.25	1.07-1.45	0.11
Other races						
Automated vs. usual	1.19	0.71-2	0.50	1.31	1.09-1.59	0.34
Personal vs. usual	2.01	1.27-3.18	<0.001	1.91	1.5-2.43	0.01
Personal vs. automated	1.68	1.12-2.52	0.01	1.45	1.13-1.86	0.11

Insurance

Patients with Medicare and private insurance were more likely to schedule and adhere to appointments than patients without insurance (self-pay) (Medicare: 58.86% vs. 10.34%; RR: 5.69; CI 1.94-16.68; p<0.001; private: 31.80% vs.

10.34%; RR: 7.13; CI 6.14-8.28; p<0.001).   Patients with Medicare were

significantly more likely than patients with Medicaid and private insurance to both

schedule an appointment (Medicaid: 58.86% vs. 30.32%; RR: 1.94; CI 1.53-2.46;

p<0.001; private insurance: 58.86% vs. 31.80%; RR: 1.85; CI 1.57-2.19;

p<0.001) and adhere to the appointment (Medicaid: 49.16% vs. 20.21%; RR:

2.43; CI 2.13-2.78; p<0.001; private insurance: 24.19%; RR: 2.03; CI 1.80-2.30;

p<0.001). The results may be seen in Table 6.

Table 6: Insurance impact on appointment scheduling and adherence

Insurance*	Scheduling			Adherence		
	RR	CI	P value	RR	CI	P value
Medicare vs. Medicaid	1.94	1.53-2.46	<0.001	2.43	2.13-2.78	<0.001
Private vs. Medicaid	1.05	0.81-1.36	0.72	1.20	1.09-1.31	0.28
Medicare vs. Private	1.85	1.57-2.19	<0.001	2.03	1.8-2.3	<0.001
Medicare vs. Self-pay	5.69	1.94-16.68	<0.001	7.13	6.14-8.28	<0.001
Medicaid vs. Self-pay	2.93	0.98-8.74	0.03	2.93	2.59-3.31	0.09
Private vs. Self-pay	3.07	1.04-9.05	0.02	3.51	3.14-3.93	0.03

*Note: Charity, self-pay, and Vision Plan were not included due to the small number of patients with those insurance types.

Both Medicare and Medicaid patients who received personal intervention

were more likely to schedule appointments than patients in the usual care

(Medicare: 71.29% vs. 49.50%; RR: 1.44; CI 1.14-1.82; p<0.001; Medicaid:

45.00% vs. 23.44%; RR: 1.92; CI 1.14-3.24; p=0.01) and automated intervention

groups (Medicare: 71.29% vs. 55.67%; RR: 1.28; CI 1.03-1.59; p=0.02; Medicaid:

45% vs. 23.44%; RR: 1.92; CI 1.14-3.24; p=0.01).   Patients with private

insurance were significantly more likely to schedule an appointment if they received personal intervention than if they received usual care (41.45% vs. 22.22%; RR: 1.87; CI 1.29-2.69; p<0.001). These results detailed in Table 7.

While Medicare patients who had personal intervention were more likely to adhere to follow-up recommendations than those who received the usual care (58.42% vs. 43.56%; RR: 1.34; CI 1.01-1.79; p=0.03), there was no significant difference in follow-up adherence in patients with private insurance or Medicaid across the three intervention groups. These results are found in Table 7.

Table 7: Impact of different interventions on appointment scheduling and adherence by insurance*

	Scheduling			Adherence		
Insurance*	RR	CI	P value	RR	CI	P value
Medicaid						
Automated vs. usual	1.00	0.53-1.87	1.00	1.20	1.02-1.41	0.64
Personal vs. usual	1.92	1.14-3.24	0.01	1.71	1.42-2.05	0.13
Personal vs. automated	1.92	1.14-3.24	0.01	1.42	1.17-1.72	0.29
Medicare						
Automated vs. usual	1.12	0.86-1.47	0.39	1.04	0.81-1.34	0.80
Personal vs. usual	1.44	1.14-1.82	<0.001	1.34	1.01-1.79	0.03
Personal vs. automated	1.28	1.03-1.59	0.02	1.29	0.96-1.73	0.07
Private						
Automated vs. usual	1.38	0.92-2.05	0.11	1.26	1.11-1.43	0.30
Personal vs. usual	1.87	1.29-2.69	<0.001	1.35	1.19-1.53	0.17
Personal vs. automated	1.35	0.99-1.84	0.05	1.07	0.94-1.23	0.72

*Note: Charity, self-pay, and Vision Plan were not included due to the small number of patients with those insurance types.

Distance

Distance from Wills Eye Hospital did not impact appointment scheduling or appointment adherence. Table 8 presents these results.

Table 8: Impact by distance from home zip code to Wills Eye Hospital on appointment scheduling and adherence

	Scheduling			Adherence		
Distance	RR	CI	P value	RR	CI	P value
0-2 vs. 2-5	0.92	0.74-1.15	0.47	0.89	0.79-1	0.36
0-2 vs. 5-20	1.06	0.84-1.33	0.63	1.06	0.94-1.19	0.69
0-2 vs. >20	1.05	0.77-1.45	0.75	0.98	0.83-1.16	0.90
2-5 vs. 5-20	1.15	0.97-1.35	0.11	1.19	1.09-1.31	0.08
2-5 vs. >20	1.14	0.86-1.51	0.34	1.10	0.95-1.28	0.55
5-20 vs. >20	1.00	0.75-1.33	0.98	0.92	0.8-1.07	0.65

However, patients who live within 0-2 miles of, within 5-20 miles of, or greater than 20 miles from Wills Eye Hospital were more likely to schedule an appointment if they received personal intervention rather than usual care (0-2 miles: 54.90% vs. 26.32%; RR: 2.09; CI 1.26-3.44; p<0.001; 5-20 miles: 50.39% vs. 29.10%; RR: 1.73; CI 1.26-2.37; p<0.001; >20 miles: 52.63% vs. 20.83%; RR: 2.53; CI 1.09-5.83; p=0.01). Patients who live 5-20 miles from Wills Eye Hospital and were part of the personal intervention group were significantly more likely to schedule a follow-up appointment compared with patients in the automated intervention group (50.39% vs. 32.80%; RR: 1.54; CI 1.13-2.08; p<0.001). Table 9 details these results.

For patients who live within 2 miles of Wills Eye Hospital, both personal and automated intervention improved follow-up adherence over usual care (personal intervention: 41.18% vs. 17.54%; RR: 2.35; CI 1.81-3.04; p=0.01) (automated intervention: 33.90% vs. 17.54%; RR: 1.93; CI 1.55-2.4; p=0.04). For patients who live greater than 20 miles from Wills Eye Hospital, personal intervention significantly improved adherence to follow-up recommendations (44.74% vs. 12.50%; RR: 3.58; CI 2.59-4.95; p=0.01). For patients who live between 2-5 miles and 5-20 miles of Wills Eye Hospital, there was no significant difference between the study groups on follow-up adherence. The results may be viewed in Table 9.

Table 9: Impact of different interventions on appointment scheduling and adherence by distance from home zip code to Wills Eye Hospital

Distance category	Scheduling			Adherence		
	RR	CI	P value	RR	CI	P value
0-2 miles						
Automated vs. usual	1.48	0.86-2.54	0.15	1.93	1.55-2.4	0.04
Personal vs. usual	2.09	1.26-3.44	<0.001	2.35	1.81-3.04	0.01
Personal vs. automated	1.41	0.94-2.11	0.10	1.21	0.91-1.63	0.43
2-5 miles						
Automated vs. usual	1.01	0.76-1.35	0.93	0.90	0.76-1.05	0.51
Personal vs. usual	1.28	0.99-1.66	0.05	1.06	0.9-1.26	0.68
Personal vs. automated	1.27	0.98-1.64	0.07	1.19	1.01-1.4	0.29
5-20 miles						
Automated vs. usual	1.13	0.78-1.62	0.52	0.98	0.85-1.13	0.92
Personal vs. usual	1.73	1.26-2.37	<0.001	1.34	1.14-1.57	0.12
Personal vs. automated	1.54	1.13-2.08	<0.001	1.36	1.16-1.6	0.11
>20 miles						
Automated vs. usual	1.55	0.62-3.89	0.33	2.35	1.81-3.07	0.13
Personal vs. usual	2.53	1.09-5.83	0.01	3.58	2.59-4.95	0.01
Personal vs. automated	1.63	0.92-2.88	0.08	1.52	1.06-2.18	0.18

DISCUSSION

Patients in the personal intervention group were significantly more likely to schedule and keep an appointment than patients in the automated or usual care groups. Automated intervention did not significantly improve scheduling or adherence over usual care. These findings are supported by previous literature that demonstrated that personal communication and multiple interventions components are more beneficial to adherence than a single, impersonal strategy (Anderson et al., 2003; Biese et al., 2014; Halbert et al., 1999; Kosoko et al., 2010; Walker et al., 2008).

It is theorized that personal intervention allowed for a connection to be made between the patient and the researcher in order to stress the importance of following up with their ophthalmic care. Automated intervention and the usual care form letter were likely unable to stress the same urgency of scheduling a follow-up appointment as a person with healthcare affiliation. People most likely disregard mail and automated appointment reminders because they are impersonal and often these reminders fail to explain the specific benefits of following up. When speaking with a person affiliated with a healthcare institution about the importance of scheduling and attending a follow-up appointment, however, a sense of necessity and concern is communicated, and people are more likely to both schedule and adhere to their recommended appointments.

In addition to analyzing the impact of intervention on adherence, this study was able to analyze differences in usage of primary eye care services at Wills

Eye Hospital. The use of the EMR system was beneficial to the study because demographic data could be easily collected about the patients in the different intervention groups. The demographic data was useful in analyzing how patients with different characteristics use primary eye care and how intervention impacted their use compared with usual care. Studies about usage of healthcare services are important to track whether individuals are getting the care they need. Identifying disparities in healthcare is critical so that strategies, such as personal intervention to improve follow-up, can be tailored to address the barriers preventing individuals from receiving adequate care. This study analyzed how age, sex, race, insurance, and distance to the eye care facility influence use of eye care services and success of intervention on adherence.

Considerations of disparities and intervention impact

Older patients were significantly more likely to schedule and adhere to appointments than younger patients. This is in agreement with previous studies showing that seniors are more likely to adhere to eye care services than younger adults (Gwira et al., 2006; Lee et al., 2009; Perron et al., 2010). This may be due to the fact that patients older than 65 are more likely to be retired and have time to attend primary eye care appointments. Another likely factor is the increased burden of vision disease on older patients due to age-related diseases such as age-related macular degeneration, cataract, diabetic eye disease, glaucoma, dry eye, and low vision (National Eye Institute, 2014). A study by the Centers for

Disease Control (CDC) found that people aged 40-64 were more likely to report "cost or lack of insurance" as the primary reason for not seeking eye care, while "no need" was the most common reason cited by those older than 65, suggesting that younger people who may need eye care are not seeking it due to real or perceived cost barriers (2011).

For patients younger than 65, personal intervention led to higher rates of both appointment scheduling and adherence, suggesting that personal intervention may improve follow-up adherence recommendations among this age group at other primary eye care centers. As Lee et al. discusses in a study of barriers to eye care utilization, it is important to establish good eye care screening practices in middle aged people so that care does not start too late (2009). The slow progression of many age-related eye diseases means that patients may not notice changes until significant disease progression, which is why it is crucial that all patients receive regular eye examinations per the American Academy of Ophthalmology's recommendations (National Eye Institute, 2014). It is therefore significant that personal intervention improved follow-up in the younger adult group that has been reported to underutilize vision health services.

In contrast, for patients 65 and older, there was no significant difference in appointment adherence between patients who received personal intervention versus the usual care. Usual care (an appointment form letter sent one month

prior to appointment and reminder call the day before the scheduled appointment) may be adequate for this older patient group.

While previous research suggests that men are less likely to adhere to follow-up recommendations, this study did not find any gender-related differences in appointment scheduling or adherence (Elam et al., 2013; Lee et al., 2009; Perron et al., 2010; Wagner & Rein, 2013). Male patients who received personal intervention were more likely to adhere to follow-up recommendations than those who received usual care. However, there was no significant impact of intervention for female patients. Personal intervention may improve adherence to follow-up in male patients who reportedly utilize eye care resources less than females at other vision health centers, while usual care may be adequate for the female population.

There were more African Americans than Caucasians in this study (53.97% vs. 26.76%). Previous literature is not in agreement about eye-care utilization by race as some studies report lower usage of eye care services by minorities while other studies report greater usage than Caucasian patients (Elam & Lee, 2013; Murakami et al., 2011; Kosoko et al., 2010; Wagner & Rein, 2013). Wills Eye Hospital is located in an urban center with a large African American population. Thus, the greater percentage of African Americans than Caucasians utilizing care at Wills Eye Hospital does not mean that African Americans are utilizing eye care services more than Caucasians on the whole.

Further study is needed to fully evaluate disparities in vision care use in this population.

No significant difference in adherence to follow-up recommendations was found between African Americans and Caucasians. Because African Americans are at greater risk than Caucasians to develop certain preventable or manageable eye diseases (Elam & Lee, 2013), adequate use of primary vision care is crucial in this population and intervention to encourage greater follow-up is particularly important. Personal intervention improved appointment scheduling and adherence compared with usual care for African Americans, but not for Caucasians. Previous studies of personal telephone intervention in the ophthalmology field to improve glaucoma medication adherence and DFEs in African American populations have also shown promising results (Anderson et al., 2003; Basch, Walker, Howard, Shamoon, & Zybert, 1999; Walker et al., 2008). Usual care may be sufficient for Caucasian patients to ensure adequate adherence; however, personal intervention in the at-risk African American population can help improve follow-up to primary eye care appointments at Wills Eye Hospital and potentially at other eye care centers as well.

The findings of this study are similar to previous studies with respect to insurance impact on adherence (Chou et al., 2014; Li, Xirasagar, Pumkam, Krishnaswamy, & Bennett, 2013; Wagner & Rein, 2013). Patients with Medicare or private insurance were more likely to schedule and adhere to recommended follow-up appointments than patients without insurance. The rollout of the

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Affordable Care Act will hopefully help alleviate disparities in vision care created by insurance and cost by increasing the number of people with vision care coverage.

Additionally, patients with Medicare were significantly more likely than patients with Medicaid and private insurance to both schedule and adhere to an appointment. This is in agreement with previous literature finding that patients with public and both public and private insurance are more likely than patients with private insurance only to utilize eye care services (Lee et al., 2009).

Patients with Medicare, Medicaid and private insurance were all more likely to schedule an appointment with personal intervention. Only Medicare patients, however, were more likely to adhere to recommended follow-up instructions with personal intervention. Since patients with Medicare insurance are more likely to schedule appointments than patients with Medicaid and private insurance, personal intervention may not have a significant impact on adherence based on insurance.

In contrast to previous studies that note accessibility as a barrier to utilization of eye care services, there was no significant impact of distance from Wills Eye Hospital on appointment scheduling or appointment adherence (Chou et al., 2012; Elam & Lee, 2013). For patients who lived within 2-20 miles of Wills Eye Hospital, there was no significant impact of either intervention on appointment adherence. However, for patients who lived greater than 20 miles from Wills Eye Hospital, personal intervention significantly improved adherence

to follow-up recommendations, suggesting that for these patients personal intervention may improve follow-up adherence among this suburban/rural population.

Limitations

A number of limitations should be considered when reviewing the results this study. Missing or inaccurate contact information prevented contact in the intervention groups and the usual care group. It is strongly recommended that full, current contact information for the patient and relatives be collected at each patient encounter. It is likely that missing contact information affected the intervention groups equally and did not impact results significantly. Additionally, the insurance status obtained from the EMR system may not have reflected the current status of the patient.

It is possible that some patients received eye care in other settings but were counted as non-adherent. Thus, the follow-up rates may be underestimated. Another, notable limitation of this study was the small number of uninsured patients did not allow for a complete analysis of personal and automated intervention impact on these at-risk patients. The small number of study subjects without insurance is probably due to the fact that they are less likely to access primary eye care at Wills Eye Hospital.

Finally, the study was conducted in an urban setting in which most of the patients are African American with Medicare or Medicaid coverage and therefore

may not be applicable to practices with other demographic distributions or in rural communities.

Future work

Further statistical analysis of the data collected in this study may yield intriguing results for the field. The EMR system at Wills Eye Hospital has the capacity collect primary, secondary, tertiary and quaternary diagnosis data for each patient. Previous studies have found that a clear diagnosis and medication prescription improve adherence to future appointments (Kosoko et al., 2010; Wagner & Rein, 2013). Future work for this study could include evaluating whether patient diagnosis/diagnoses impacted follow-up adherence. Additionally, examination of adherence by type of ocular diagnosis could have important implications for what diseases require education about the importance of follow-up care.

The impact of time to follow-up on appointment adherence is another statistical analysis that could be performed with the data collected by the EMR system. Previous studies have suggested that more frequent visits lead to greater appointment adherence (Henry, Goetz, & Asch, 2012). An examination of the impact of time to follow-up on adherence could yield interesting results with clinical implications for follow-up recommendations.

Future work may also include the evaluation of the cost-effectiveness of personal intervention at Wills Eye Hospital. While the results of this study were

encouraging with respect to personal intervention, it is important to conduct a full cost-benefit analysis as personal intervention requires significant resources, including time, personnel, and funding (Vervloet et al., 2012). Furthermore, follow-up adherence's impact on patient vision outcomes should be considered when calculating the cost-effectiveness of personal intervention. Murakami et al. notes that little attention has been given to inconsistent adherence to recommended follow-up visits as a predictive factor for vision loss (2011). This type of endpoint will help fully evaluate cost-effectiveness of personal intervention to improve follow-up adherence to primary eye care appointments.

Finally, evaluation of this type of intervention in other ophthalmic care centers is necessary to determine whether other centers would benefit from similar process changes. Personal intervention may not be feasible at other primary eye care centers due to personnel and resource constraints.

Conclusions

This study has shown that in a primary eye care setting, personal intervention consisting of a mailed letter, phone call to schedule an eye examination appointment, and a reminder phone call prior to the appointment can increase patient adherence to recommended follow-up appointments. Personal intervention improved follow-up over usual care by more than 10%, from 27.47% to 37.70%.

Personal intervention improved adherence for patients who have been previously recognized as at risk including men, African Americans, patients younger than 65, and patients who live greater than 20 miles from Wills Eye Hospital. The information about intervention impact overall and by demographic information will help inform institutional decisions about implementing personal intervention to improve follow-up care.

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CURRICULUM VITAE

Catherine E. Callinan

<u>**YEAR OF BIRTH**</u> 1990

<u>**CONTACT INFORMATION**</u>
Email address: callinan@bu.edu
Permanent address: 1875 Willow Rd, Hillsborough, CA 94010

<u>**EDUCATION**</u>
Boston University School of Medicine, Division of Graduate Medical Sciences, Boston, MA
Masters of Science in Medical Science, September 2014
Cumulative GPA: 3.91

New York University, New York, NY
Coursework in Genetics, July 2013
GPA: 4.0

University of Pennsylvania, School of Engineering & Applied Science, Philadelphia, PA
Bachelor of Science of Engineering, May 2012
Major: Bioengineering, Cumulative GPA: 3.35

<u>**RESEARCH EXPERIENCE**</u>
Recruitment Manager & Research Assistant, Wills Eye Institute, Department of Clinical Research, Philadelphia, PA
May 2014-current
- Reviewed charts from various Wills Eye Hospital services to find potential patients for a clinical trial of transcorneal electrical stimulation and contacted and scheduled patient screening visits; support research coordinator with reporting and patient visits

Clinical Research Assistant, Wills Eye Institute, Department of Clinical Research, Philadelphia, PA
September 2011-January 2012
- Performed comprehensive, retrospective chart to determine impact of prophylactic topical nonsteroidal anti-inflammatory drugs (NSAIDs) on the rate of development of cystoid macular edema following cataract surgery; found that NSAIDs had no significant impact on the rate of development of cystoid macular edema

Research Assistant, University of Pennsylvania Medical School, Department of Ophthalmology, Philadelphia, PA

November 2010-August 2011
- Designed and executed cell-line experiments modeling retinal ganglion cell death due to optic neuritis caused by multiple sclerosis

Research Assistant, University of Pennsylvania School of Engineering & Applied Science, Philadelphia, PA
January 2009-May 2009
- Analyzed patient brain MRIs for evidence of epileptic tubers

EMPLOYMENT HISTORY
Independent tutor, Boston, MA
January 2014-Current
- Tutor high school and college students in precalculus and trigonometry

Associate Consultant, Healthcare Vertical, Rosetta Marketing Group, New York, NY
August 2012-August 2013
- Supported the senior marketing team of a global pharmaceutical company with market research and strategy for a small molecule drug that treats hyponatremia

Summer Intern, Regulatory Affairs, Chemical Manufacturing & Controls, Gilead Sciences, Foster City, CA
May 2010-August 2010
- Compiled regulatory intelligence from CDC and NIH clinical studies and presented major clinical findings and public safety concerns to senior members of Regulatory Affairs
- Drafted IND submissions for Pre-exposure Prophylaxis for HIV
- Developed and tested Liquent-driven database of global manufacturing and distribution details to ensure compliance

CLINICAL VOLUNTEERING EXPERIENCES
Volunteer, Village Care Rehabilitation and Nursing Center, New York, NY
April 2013-September 2013
- Visit with patients in their rooms and the common areas of the center and deliver them books, puzzles, and games
- Help coordinate social activities including volunteer visits and social hours

Volunteer, Wills Eye Institute, Philadelphia, PA
September 2011-May 2012
- Greeted patients and distributed survey about patients' use of social media in departmental waiting rooms contributing to improved patient experience and data for the study

Director of Follow-up Care and Volunteer, Focus First Philly, Philadelphia, PA
January 2011-January 2012
- Directed weekly eye screenings and coordinated follow-up care for preschool children, screening thousands of children per year in the Philadelphia area and helping them receive vision care
- Attended regular meetings with Philadelphia's Vision Care Coalition Team to help plan Give Kid's Sight Day, contributing an the event that brought free glasses to around 2,000 uninsured children in Philadelphia

LEADERSHIP EXPERIENCE
Advisory Board Member, Advancing Women in Engineering, University of Pennsylvania School of Applied Science in Engineering, Philadelphia, PA
January 2009-May 2012
- Conceived and coordinated networking and mentoring events for women in engineering

Tour Guide, Hexagon Senior Society, University of Pennsylvania School of Applied Science in Engineering, Philadelphia, PA
September 2011-May 2012
- Led tours of the engineering school for prospective students

Vision Care Coalition Team Member, Philadelphia, PA
September 2010-May 2012
- Helped Give Kids Sight Day, which was a day where children from Philadelphia could receive free eye screening and a pair of glasses

Vice President of Development, Kappa Alpha Theta Fraternity, University of Pennsylvania, Philadelphia, PA
January 2011-May 2012
- Responsible for all sisterhood and social programming
- Managed the Member Development Committee which holds members accountable for their actions when they violate chapter bylaws

Philanthropy Chair, Kappa Alpha Theta Fraternity, University of Pennsylvania
September 2011-January 2012
- Planned and structured many community service events for the members of the fraternity
- Organized a soccer tournament that raised over $5000 for Huntington's Disease Society of America

Chorus Member, Soloist, CD Manager, Penny Loafers A Cappella Group, University of Pennsylvania, Philadelphia, PA

September 2009-January 2011
- Sang group-written arrangements of popular songs as a member of the chorus and as a soloist
- Managed CD sales from online platform

<u>HOBBIES</u>
Yoga, running, sailing, cooking and baking, collecting shells and sea glass

<u>OTHER SKILLS</u>
Microsoft Excel, Microsoft PowerPoint, SPSS, MATLAB