

Interpreting Services Bridge Language Gaps in Diabetic Retinopathy Care: A Retrospective Cohort Study

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Purpose: In patients with diabetic retinopathy (DR), vision loss can be prevented through consistent follow-up. Patients can be lost to follow-up (LTFU) for several reasons, including language barriers between the patient and the healthcare provider. This language discordance is known to contribute to nonadherence to diabetic care, but its role in non-adherence among patients with DR has not been studied. Here, we compare follow-up between Spanish-speaking patients with interpreters (SSI) and English-speaking (ES) patients receiving intravitreal injections for DR to determine whether language discordance impacts follow-up when interpreting services are provided.

Patients and methods: This retrospective cohort study included patients with either non-proliferative DR with diabetic macular edema or proliferative DR, and who received anti-vascular endothelial growth factor injections at The University of Kansas Health System between January 1, 2012, and April 1, 2022. These patients were treated by English-speaking retina specialists, so all Spanish-speaking patients were offered interpreting services. Patients were excluded if they had no injections before April 1, 2021, or if they passed away during the study period. Patients were defined as SSI or ES based on self-reported preferred language. Patients were defined as adherent to follow-up (ATFU) if they returned to clinic within 1 month of the recommended time. LTFU was defined as no subsequent clinic visits within 12 months of an injection.

Results: Of the 527 patients, 57 (10.8%) were SSI and 470 (89.2%) were ES. Groups did not significantly differ in rates of ATFU after the initial clinic visit (78.9% SSI vs 82.8% ES; $p = 0.475$) or after injections (80.7% SSI vs 82.3% ES; $p = 0.760$). LTFU rates were similar between groups (57.9% SSI vs 67.2% ES; $p = 0.159$), but the pattern of LTFU differed significantly ($p = 0.045$). We found that SSI status was protective against LTFU (HR 0.692; $p = 0.047$), even after adjusting for demographic and clinical confounders (aHR 0.534; $p = 0.024$).

Conclusion: When language discordance was addressed with interpreting services, SSI patients had similar and even superior follow-up adherence compared to ES counterparts. This demonstrates the value of interpreting services in retina specialty care. Future prospective studies can clarify the relationship between language and follow-up.

Plain Language Summary: Diabetic retinopathy is an eye disease that can cause people to lose their vision if they are not monitored and treated appropriately. To protect their vision, many patients with diabetic retinopathy need medicine to be injected into their eyes on a regular basis. However, keeping up with appointments can be difficult, especially when patients do not speak the same language as their healthcare providers. We wanted to know if language discordance could discourage patients from attending follow-up appointments for diabetic retinopathy, even when they had access to professional telephone interpreting services.



This study assessed patients at The University of Kansas Health System who received injections for diabetic retinopathy between 2012 and 2022. We compared Spanish-speaking patients with interpreters to English-speaking patients to determine whether language affected their ability to return for follow-up visits.

We studied 527 patients. The two groups had similar follow-up rates after their first retina clinic visits and injections. Surprisingly, Spanish-speaking patients stayed in care longer than English-speaking patients.

These findings suggest that, when professional telephone interpreting services are available, language barriers do not reduce follow-up adherence, and may even support better long-term engagement with diabetic eye care.

Keywords: adherence, interpreter, intravitreal injections, language barriers, loss to follow-up

Introduction

Diabetic retinopathy (DR) is a leading cause of preventable vision loss.¹ Intravitreal injections (IVI) with anti-vascular endothelial growth factor (VEGF) effectively improve visual acuity outcomes among patients with diabetic macular edema (DME).² However, the therapeutic benefits of anti-VEGF therapy can be limited by suboptimal injection frequency.² Adherence to follow-up visits is key to preventing vision loss due to DR but can be challenging for patients.^{3,4}

Hispanic adults have a higher likelihood of developing type II diabetes compared to their White counterparts and develop it at least ten years earlier.⁵ Results of a large epidemiologic study suggested that diabetic retinopathy is more prevalent among Hispanics compared to Whites.⁶ However, it can be difficult for Hispanic patients to access providers who speak their same language and understand the cultural values these patients hold.^{7,8} These challenges can be understood through Penchansky and Thomas' framework, where factors like availability of services, accommodation of patient preferences, and cultural acceptability interact to impact access.⁹ Language and cultural barriers have been observed to impede Hispanic patients from accessing and adhering to diabetic care.⁸ Additionally, language discordance increases the likelihood of patients to report suboptimal diabetic care in terms of mistrust, miscommunication, and discrimination.⁸ Conversely, access to culturally appropriate Spanish interpreting services and Spanish-speaking primary care physicians leads to improved glycemic control and HbA1C levels.^{10,11} However, no studies have investigated measures to address language disparities in the context of retina specialty care, to our knowledge.

The objective of this study was to compare follow-up adherence between Spanish-speaking (SS) and English-speaking (ES) patients receiving anti-VEGF IVIs for DR from retina specialists at the University of Kansas Eye Center, affiliated with The University of Kansas Health System (TUKHS). TUKHS serves a diverse regional catchment area, primarily encompassing Wyandotte County (33.0% Hispanic; 26.5% SS; 13.8% below the poverty line; 16.8% uninsured)—and Johnson County, (8.9% Hispanic; 5.6% SS; 6.4% below the poverty line; 5.2% uninsured).^{12,13} All retina specialists involved in this study spoke English only, so telephone interpreting services were made available for SS patients. We hypothesized that providing interpreting services to SS patients would reduce language discordance and thereby enable SS patients to achieve follow-up rates similar to those of ES patients.

Methods

This retrospective cohort study received ethical approval from the University of Kansas Medical Center Institutional Review Board (STUDY00160718) with a waiver of informed consent because the research was conducted with de-identified data and posed minimal risk to the participants. This study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki.

Retrospective chart reviews were performed using electronic medical record (EMR) data. Inclusion criteria were patients with either non-proliferative diabetic retinopathy (NPDR) with DME or proliferative diabetic retinopathy (PDR) who received anti-VEGF IVIs from retina specialists at the University of Kansas Eye Center between January 1, 2012, and April 1, 2022. Patients whose preferred language was neither Spanish nor English, who had no injections before April 1, 2021, or who passed away within the study period were excluded from the cohort.

Patients were defined as SS using interpreters (SSI) or ES based on self-reported preferred language. The following other demographic variables were extracted: age, sex, self-identified race and ethnicity, distance from the patient's primary

residence to the ophthalmology clinic in miles, and insurance status. Baseline HbA1c and best corrected visual acuity (BCVA) were collected as clinical proxies for systemic glycemic control and DR severity, respectively. The primary outcome was adherence to follow-up (ATFU) after a patient's first retina clinic visit, defined as returning to clinic within 1 month of the recommended time. Given that the standard of care for anti-VEGF therapy outlined by the American Diabetes Association involves IVIs every 4–8 weeks, this 1-month threshold was selected as a pragmatic clinical window to ensure the definition of ATFU captures patients who returned for care before missing a full treatment cycle while also accounting for scheduling delays.¹⁴ Secondary outcomes were ATFU after a patient's first anti-VEGF IVI; loss to follow-up (LTFU), defined as no subsequent retina clinic visits within 12 months after receiving an anti-VEGF IVI; and time to LTFU, defined as the days elapsed between a patient's first retina clinic visit and last anti-VEGF IVI.

Statistical analyses were performed using IBM SPSS Statistics (version 31.0). Continuous variables were assessed for normality. Age and baseline HbA1c were expressed as means with standard deviations (SD) and compared between SSI and ES using independent samples *t*-tests. Due to skewed distributions, distance to clinic and time to LTFU were expressed as medians with interquartile ranges (IQR) and compared using the Wilcoxon rank-sum test. Categorical variables were compared using the Chi-square test when cell frequencies were greater than five, and Fisher's exact test when cell frequencies were five or fewer. Time to LTFU was analyzed using Kaplan-Meier survival curves and the Log rank test. The association between language and time to LTFU was assessed using an unadjusted Cox proportional hazards regression to calculate the crude hazard ratio (HR). To account for baseline differences between SSI and ES groups, a multivariable Cox proportional hazards regression model was then constructed to calculate the adjusted hazard ratio (aHR), controlling for age, sex, race, ethnicity, distance to clinic, insurance status, and baseline BCVA. Proportional hazards assumptions for the Cox regression models were tested via visual inspection of the Kaplan-Meier curves and the inclusion of time-dependent covariates. To account for late-term crossing of the survival curves, a sensitivity analysis was performed by truncating follow-up at 1000 days to evaluate the stability of the HRs. All tests were two-sided, and a *p*-value of <0.05 was considered statistically significant.

Results

Of the 527 patients who met inclusion criteria, 57 (10.8%) were SSI, and 470 (89.2%) were ES. Table 1 summarizes the baseline demographic and clinical characteristics of the cohort. SSI were younger (mean age 54.6 years [SD 10.6] SSI vs

Table 1 Description and Comparison of Baseline Demographic and Clinical Characteristics in Spanish- and English-Speaking Patients

	Spanish-Speaking n = 57	English-Speaking n = 470	Total n = 527	<i>p</i>
Age in years, mean (SD)	54.6 (10.6)	60.6 (44.1)	60.0 (41.8)	0.014 ^A
Sex, n (%)				
Male	40 (70.2%)	254 (54.0%)	294 (55.8%)	0.021 ^B
Female	17 (29.8%)	216 (46.0%)	233 (44.2%)	0.021 ^B
Race, n (%)				
Asian	0 (0.0%)	5 (1.1%)	5 (0.9%)	1.000 ^C
Black	0 (0.0%)	152 (32.3%)	152 (28.8%)	<0.001 ^C
White	4 (7.0%)	262 (55.7%)	266 (50.5%)	<0.001 ^B
Other	52 (91.2%)	47 (10.0%)	99 (18.8%)	<0.001 ^B
Missing	1 (1.8%)	4 (0.9%)	5 (0.9%)	0.437 ^C

(Continued)

Table 1 (Continued).

	Spanish-Speaking n = 57	English-Speaking n = 470	Total n = 527	p
Ethnicity, n (%)				
Hispanic	51 (89.5%)	38 (8.1%)	89 (16.9%)	<0.001 ^B
Non-Hispanic	5 (8.8%)	427 (90.9%)	432 (82.0%)	<0.001 ^B
Missing	1 (1.8%)	5 (1.1%)	6 (1.1%)	0.499 ^C
Distance to clinic (miles), median (IQR)				
<5 miles, n (%)	19 (33.3%)	96 (20.4%)	115 (21.8%)	0.026 ^B
5–10 miles, n (%)	16 (28.1%)	81 (17.2%)	97 (18.4%)	0.046 ^B
11–15 miles, n (%)	10 (17.5%)	112 (23.8%)	112 (23.1%)	0.288 ^B
16–20 miles, n (%)	8 (14.0%)	72 (15.3%)	80 (15.2%)	0.799 ^B
21–50 miles, n (%)	2 (3.5%)	61 (13.0%)	63 (12.0%)	0.037 ^B
51–100 miles, n (%)	0 (0.0%)	25 (5.3%)	25 (4.7%)	0.096 ^C
101–200 miles, n (%)	2 (3.5%)	13 (2.8%)	15 (2.8%)	0.671 ^C
Insurance status, n (%)				
Commercial	16 (28.1%)	150 (31.9%)	166 (31.5%)	0.555 ^B
Medicaid	4 (7.0%)	27 (5.7%)	31 (5.9%)	0.763 ^C
Medicare	4 (7.0%)	70 (14.9%)	74 (14.0%)	0.106 ^B
Medicare Advantage	7 (12.3%)	127 (27.0%)	134 (25.4%)	0.016 ^B
Military	0 (0.0%)	37 (7.9%)	37 (7.0%)	0.024 ^C
Self-pay	11 (19.3%)	42 (8.9%)	53 (10.1%)	0.014 ^B
Other	10 (17.5%)	10 (2.1%)	20 (3.8%)	<0.001 ^C
Missing	5 (8.8%)	7 (1.5%)	12 (2.3%)	0.005 ^C
Baseline HbA1c, mean (SD)				
Missing, n (%)	30 (52.6%)	232 (49.4%)	262 (49.7%)	0.641 ^B
Baseline BCVA (Snellen), n (%)				
20/40 or better	29 (50.9%)	359 (76.4%)	388 (73.6%)	<0.001 ^B
20/50 to 20/80	10 (17.5%)	67 (14.3%)	77 (14.6%)	0.550 ^B
20/90 to 20/200	6 (10.5%)	21 (4.5%)	27 (5.1%)	0.060 ^C
Worse than 20/200	11 (19.3%)	17 (3.6%)	28 (5.3%)	<0.001 ^C
Missing	1 (1.8%)	6 (1.3%)	7 (1.3%)	0.553 ^C

Notes: ^AIndependent samples t-test. ^BChi-square test. ^CFisher's exact test. ^DWilcoxon rank-sum test.

60.6 years [SD 44.1] ES; $p = 0.014$) and had a higher proportion of male patients (70.2% SSI vs 54.0% ES; $p = 0.021$). Fewer SSI identified as Black (0.0% SSI vs 32.3% ES; $p < 0.001$) or White (7.0% SSI vs 55.7% ES; $p < 0.001$), whereas more SSI were of other race (91.2% SSI vs 10.0% ES; $p < 0.001$). More SSI were Hispanic (89.5% SSI vs 8.1% ES; $p < 0.001$). SSI lived closer to the clinic as indicated by median distance from the clinic (10 miles [IQR 5–15] SSI vs 15 miles [IQR 10–20] ES; $p = 0.001$) and percent who lived less than five miles from clinic (33.3% SSI vs 20.4% ES; $p = 0.026$) and five to ten miles from clinic (28.1% SSI vs 17.2% ES; $p = 0.046$). Enrollment in commercial insurance plans, Medicaid, and traditional Medicare were similar between groups. SS were less likely to be enrolled in Medicare Advantage plans (12.3% SSI vs 27.0% ES; $p = 0.016$) or have military benefits (0.0% SSI vs 7.9% ES; $p = 0.024$). Meanwhile, SSI were more likely to be self-pay (19.3% SSI vs 8.9% ES; $p = 0.014$) or under other coverage such as charitable or safety net programs (17.5% SSI vs 2.1% ES; $p < 0.001$). There were no significant differences in baseline HbA1c between groups (9.1 [SD 2.5] SSI vs 8.7 [SD 2.4] ES; $p = 0.434$). SSI had worse baseline BCVA, with fewer SSI having a baseline BCVA of 20/40 or better (50.9% SSI vs 76.4% ES; $p < 0.001$) and more SSI with a baseline BCVA worse than 20/200 (19.3% SSI vs 3.6% ES; $p < 0.001$).

Table 2 compares follow-up between SSI and ES. ATFU rates after the initial retina clinic visit were similar between groups (78.9% [95% CI 68.0–89.9%] SSI vs 82.8% [95% CI 79.3–86.2%] ES; $p = 0.475$). Similarly, there were no significant differences in ATFU rates after the first anti-VEGF IVI (80.7% [95% CI 70.1–91.3%] SSI vs 82.3% [95% CI 78.9–85.8%] ES; $p = 0.760$). There were no significant differences in LTFU rates (57.9% [95% CI 44.7–71.1%] SSI vs 67.2% [95% CI 63.0–71.5%] ES; $p = 0.159$) and days elapsed between the initial retina clinic visit and LTFU (627 days [95% CI 164–1091] SSI vs 412 [95% CI 59–766] ES; $p = 0.096$). However, the pattern of LTFU differed significantly between SSI and ES patients as determined by the Log rank test ($p = 0.045$) and as visualized on the Kaplan-Meier survival curves (**Figure 1**).

An unadjusted Cox proportional hazards regression determined SSI status to have a significantly protective effect against LTFU (HR 0.692 [95% CI 0.480–0.996]; $p = 0.047$). Furthermore, after adjusting for demographic and clinical confounders (age, sex, race, ethnicity, distance to clinic, insurance status, and baseline BCVA), SSI status remained a significant independent predictor of improved retention (aHR 0.534 [95% CI 0.310–0.922]; $p = 0.024$). Baseline HbA1c was not included in the model because it was missing in 49.7% of cases and was not found to be significantly different between SSI and ES groups. While this model demonstrated a violation of the proportional hazards assumptions ($p = 0.012$), visual inspection of the Kaplan-Meier curves (**Figure 1**) confirmed that SSI and ES groups diverged early and maintained a consistent separation until crossing late in the study period. In a sensitivity analysis truncated at 1000 days, the proportional hazards assumptions were met ($p = 0.057$), and the protective effect of language remained significant ($p = 0.009$) and was even more pronounced (aHR 0.378 [95% CI 0.181–0.788]). Therefore, the aHRs in **Table 3** are presented as clinically representative averages of the effects of various factors on LTFU, as determined by the multi-variable Cox proportional hazards regression model. Distance to clinic was significantly associated with higher LTFU risk ($p = 0.031$), and age was borderline significantly associated with higher LTFU risk ($p = 0.050$). Sex, race, ethnicity, insurance status, and baseline BCVA were not found to significantly impact LTFU.

Table 2 Description and Comparison of Follow-Up in Spanish- and English-Speaking Patients

	Spanish-Speaking n = 57	English-Speaking n = 470	Total n = 527	p
Adherence to follow-up, n (% , 95% CI)				
After 1 st retina clinic visit	45 (78.9%, 68.0–89.9%)	389 (82.8%, 79.3–86.2%)	434 (82.4%, 79.1–85.6%)	0.475 ^A
After 1 st anti-VEGF IVI	46 (80.7%, 70.1–91.3%)	387 (82.3%, 78.9–85.8%)	433 (82.2%, 78.9–85.4%)	0.760 ^A
Loss to follow-up, n (% , 95% CI)	33 (57.9%, 44.7–71.1%)	316 (67.2%, 63.0–71.5%)	349 (66.2%, 62.2–70.3%)	0.159 ^A
Time to loss-to-follow-up (days, median (IQR))	627 (164–1091)	412 (59–766)	432 (72–792)	0.096 ^B

Notes: ^AChi-square test. ^BWilcoxon rank-sum test.

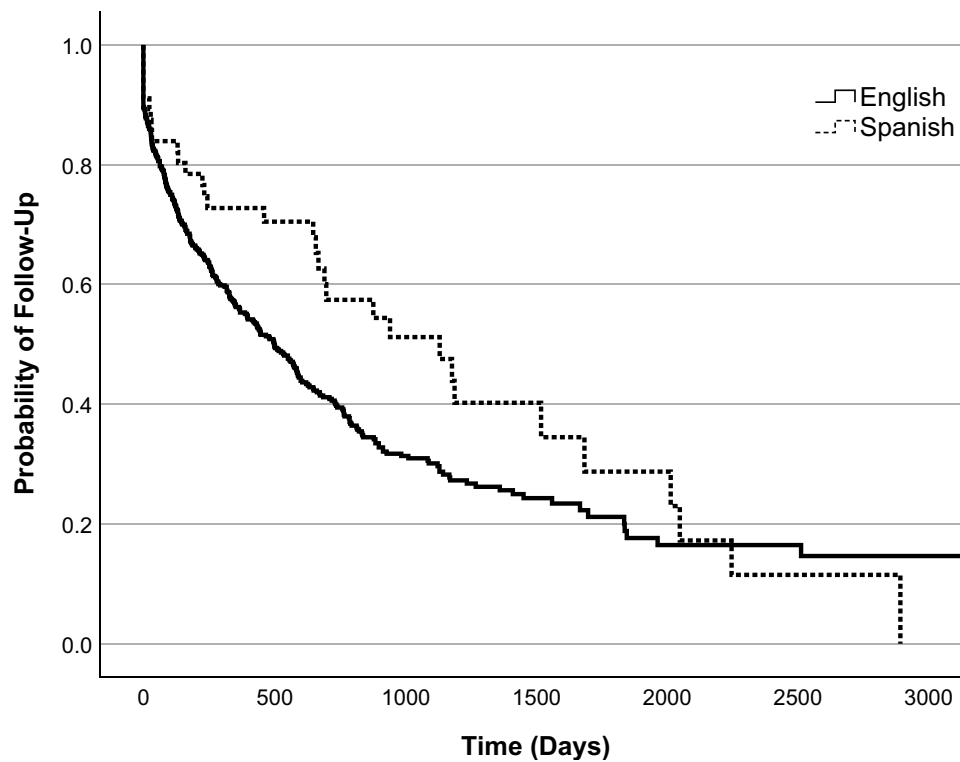


Figure 1 Time to Loss to Follow-Up in Spanish- and English-Speaking Patients.

Discussion

When comparing SSI and ES patients receiving anti-VEGF IVIs for DME or PDR, we found that, when interpreting services were provided, patients' preferred language did not significantly impact rates of ATFU after the initial retina clinic visit ($p = 0.475$) and after the first anti-VEGF IVI ($p = 0.760$). While no significant differences were observed in overall LTFU rates ($p = 0.159$), the pattern of LTFU differed significantly, a finding consistent across the Log rank test ($p = 0.045$), unadjusted Cox regression ($p = 0.047$), and when adjusting for potential confounders ($p = 0.024$). SSI status was observed to be protective against LTFU over 2000 days into the study period. To our knowledge, this is the first study to specifically address the impact of language on follow-up adherence in the context of DR care.

Studies in the literature showed that language is an important contributor to adherence to diabetic care, and consequently to health outcomes.^{8,10,11} While it is ideal for patients to receive care from providers who speak their same language, it can be difficult for SS patients to access language-concordant providers.^{7,8} The results of our study

Table 3 Impact of Various Factors on Loss to Follow-Up

	aHR	95% CI	p
Age (per year)	1.002	1.000–1.005	0.050
Sex	1.141	0.892–1.460	0.294
Race			
Asian	2.317	0.815–6.588	0.115
Black	1.239	0.941–1.631	0.126
White	Reference	–	0.215
Other	0.950	0.542–1.667	0.859

(Continued)

Table 3 (Continued).

	aHR	95% CI	p
Ethnicity			
Hispanic	1.636	0.896–2.987	0.109
Non-Hispanic	Reference	–	0.243
Language	0.534	0.310–0.922	0.024
Distance to clinic			
<5 miles	Reference	–	0.031
6–10 miles	0.971	0.682–1.382	0.869
11–15 miles	1.011	0.718–1.424	0.950
16–20 miles	1.375	0.950–1.990	0.092
21–50 miles	0.927	0.611–1.407	0.722
51–100 miles	1.294	0.747–2.240	0.358
>100 miles	2.568	1.341–4.920	0.004
Insurance status			
Commercial	Reference	–	0.588
Medicaid	1.458	0.849–2.503	0.171
Medicare	1.088	0.754–1.571	0.652
Medicare Advantage	0.898	0.663–1.216	0.486
Military	1.201	0.768–1.879	0.421
Self-pay	1.189	0.800–1.766	0.392
Other	0.860	0.427–1.732	0.674
Baseline BCVA (Snellen)			
20/40 or better	Reference	–	0.658
20/50 to 20/80	1.200	0.876–1.646	0.257
20/90 to 20/200	0.945	0.557–1.601	0.832
Worse than 20/200	0.905	0.493–1.661	0.748

suggest that when language barriers are addressed via telephone interpreting services, SS patients may seek, implement, and sustain DR care to a similar or even greater degree compared to ES patients.

It is worth mentioning that baseline differences were observed between SSI and ES groups, some of which were found to significantly impact LTFU, although these factors were adjusted for in the multivariate analysis. SSI patients were generally younger (54.6 years) than ES patients (60.6 years; $p = 0.014$), which may have impacted follow-up, given that age was identified as a borderline significant predictor of increased LTFU ($p = 0.050$). The age difference between SSI and ES patients is consistent with the fact that Hispanic adults tend to develop type II diabetes at a younger age compared to their non-Hispanic White counterparts.⁵ However, the impact of age on follow-up adherence among patients with DR remains unclear. Gutierrez et al noted a significant correlation between frailty and LTFU among patients with DR, consistent with our observation that advanced age increases LTFU risk.¹⁵ Meanwhile, other studies reported an opposite association.^{7,16} Some have noted that younger patients tend

to have more employment and caregiving obligations compared to older patients, resulting in time constraints that may preclude follow-up adherence among younger patients.^{7,17} More research is necessary to clarify the impact of age on follow-up adherence. Furthermore, SSI generally lived closer to the clinic, which was determined to be protective against LTFU ($p = 0.031$), a finding consistent with the literature.^{17,18} Together, these findings paint a much more complex picture than language alone affecting access to care. Rather, access to care is a multifactorial issue, well-described by Penchansky and Thomas' conceptual framework: availability of services, geographic factors, affordability, accommodation of patient needs and preferences, and cultural compatibility between providers and patients all interact to affect access.⁹

Limitations

This study has some limitations. First, the retrospective cohort study design confers the ability to observe associations and make inferences about causality, but a prospective study is necessary to verify the temporal association between the intervention and outcome. Second, the variables analyzed were limited to what could be retrospectively collected from the EMR. Adjustment for socioeconomic status was limited to insurance status, as other measures (eg, education level, employment status, annual household income) were not consistently available in the EMR. Additionally, some SS patients may have declined telephone interpreting services and preferred to have a family member or friend interpret instead, but this was not recorded in the EMR. Hence, while we could be certain that all SS patients had an interpreter and were allowed to use the option that was most comfortable for them, we were unable to determine what percentage utilized the provided professional services vs preferring a family member or friend to interpret, nor were we able to directly measure the efficacy of the interpreting. Patient preferences were honored in these cases, but interpreters lacking formal training have been observed to make twice as many errors (eg, omissions, substitutions, additions) compared to professional interpreters.¹⁹ Meanwhile, professional telephone interpreting services resulted in statistically similar concordance in understanding to in-person interpretation and bilingual providers in the emergency department setting, although additional research is necessary to determine whether this holds true in a retina specialty care setting.²⁰ Third, some differences associated with LTFU rates may have been missed due to our sample size. We observed no significant associations of LTFU with race, ethnicity, insurance status, and baseline visual acuity—factors that larger studies have associated with LTFU.^{16,17,21–26}

Despite no significant difference in LTFU rates between SSI and ES groups, our total LTFU rate (66.2%) was relatively high compared to LTFU rates in the literature (11.7–61.2%).^{7,15–18,21–25,27,28} While the focus of this study was to investigate language-based differences and not the total LTFU rate, multiple factors could have impacted our LTFU rate. First, patients who might have transferred their DR care from the University of Kansas Eye Center to another institution were still counted as LTFU even if they had continued their DR care elsewhere. Patients with severe disease may be referred to an academic center like the University of Kansas Eye Center for initial management but transfer care to clinics closer to their homes once they have achieved some stabilization of their disease. Hence, our observed LTFU rate may not be representative of private practice settings or other geographical areas. Second, during the study period, the University of Kansas Eye Center's only retina surgeon relocated, so patients followed with visiting retina specialists who were contracted from local practices. When the University of Kansas Eye Center hired new retina faculty, some patients transferred their care to the other local practices to continue following with the retina specialists they had been seeing. Third, the COVID-19 pandemic could have impacted LTFU in patients who were followed into 2020 and the subsequent years. However, it is worth mentioning that it is difficult to make direct comparisons between our LTFU rate and other published LTFU rates due to variations in study duration (ranging from two to ten years in the literature), since a patient who is not counted as LTFU in a shorter study could eventually become LTFU if observed longer.^{7,15–17,21,22,27,28} Median time to LTFU may serve as a more direct comparison across studies, but this was not reported in any of the cited literature.

Clinical Implications and Future Directions

Our findings support the use of professional interpreting services as a promising intervention to facilitate follow-up among SS patients. However, the overall high LTFU rate highlights the need for system-level interventions beyond interpreting services to improve follow-up. Atta et al demonstrated that EMR-based reminder messages can promote engagement in ophthalmology care.²⁹ Lam et al proposed the use of artificial intelligence to screen for DME from fundus photography and optical coherence tomography images in primary care and optometry settings.³⁰ With advancements in

technology, this idea may be extended to routine DR monitoring. Such shared-care or teleophthalmology models would reduce travel burden for routine monitoring visits, only requiring patients to travel to the retina specialty clinic for injections, which may improve follow-up in patients who live far away. Furthermore, Montaser and Shah have demonstrated that machine learning models can predict diabetic retinopathy risk using clinical and glycemic data, highlighting an opportunity to identify patients at higher risk of disease progression or LTFU and to implement targeted interventions that may improve long-term engagement in care.³¹

Conclusion

In this 10-year retrospective cohort study, we observed that SSI patients receiving anti-VEGF IVIs for DR had similar follow-up adherence compared to ES patients. SSI status was even found to be an independent protective factor against LTFU when telephone interpreting services were provided. Together, these findings suggest that interpreting services could aid in addressing language barriers and promote follow-up adherence, which is vital to successfully managing DR, although prospective studies are necessary to confirm causality. Conversely, greater distance to clinic was observed to be a significant driver of LTFU. While interpreting services may mitigate certain barriers to care, our high overall LTFU rate highlights a critical need for system-level interventions—such as reminder messages and teleophthalmology care models—to improve treatment persistence and preserve vision.

Abbreviations

ATFU, adherence to follow-up; BCVA, best corrected visual acuity; CI, confidence interval; DME, diabetic macular edema; DR, diabetic retinopathy; EMR, electronic medical record; ES, English-speaking; HR, hazard ratio; aHR, adjusted hazard ratio; IQR, interquartile range; IVI, intravitreal injection; LTFU, loss to follow-up; NPDR, non-proliferative diabetic retinopathy; PDR, proliferative diabetic retinopathy; SD, standard deviation; SS, Spanish-speaking; SSI, Spanish-speaking using interpreter; VEGF, vascular endothelial growth factor.

Data Sharing Statement

The data supporting this study are available on request from the corresponding author.

Acknowledgments

The authors gratefully acknowledge Brian Egan, medical writer at the University of Kansas Medical Center, for his assistance with editing this manuscript.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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