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Implementation and challenges unique to teleretinal diabetic retinal screening (TDRS) in a private practice setting in the United States

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ABSTRACT

Purpose: Adherence rates to published guidelines for diabetic retinopathy (DR) screening is between 35 and 60%. We evaluate a teleretinal DR screening (TDRS) program in a private practice vertically integrated system to increase compliance with retinal screening.

Methods: A retrospective pre-post intervention longitudinal study was conducted in a private endocrinology practice using TDRS as the primary intervention. Compliance rates for diabetic retinal screening were compared between December 31, 2016 and December 31, 2018.

Results: A total population of 3479 patients were evaluated. Retinal screening compliance improved from 56.5% of patients (1964) pre-intervention to 59.3% of patients (2064) post intervention. The McNemar test was used for statistical analysis and found the change significant (p = 0.004).

Conclusions: TDRS as an adjunct tool in a private practice endocrinology office significantly improved screening rates and can increase access to recommended diabetic eye care. However, the improvement in screening rates was smaller than other types of practice settings. We explore some of the unique challenges to implementation of TDRS in private practice settings.

Introduction

Over 29 million people in the United States have diabetes mellitus (DM) [1]. Early detection and treatments of diabetic retinopathy (DR), along with optimal blood pressure and glucose control can prevent vision loss in this population. For this reason, the American Diabetes Association (ADA) recommends yearly eye exams to screen diabetic patients for DR [2]. Adherence rates to guidelines for retinal screening remains stubbornly low in the United States ranging from 35 to 60% [3–5]. As quality billing and merit-based incentive payment systems become the norm, it is becoming increasingly important to combat low screening rates from both the patient care and pay for performance vantage points. Diabetic screening remains a cost-effective intervention when compared to social and economic cost of blindness [6,7]. While many studies have been conducted to find reasons behind the low screening rates of patients with diabetes, few have found ways to increase these rates in private practice settings. Low screening rates among patients with diabetes have a profound impact as diabetes is the leading cause of new onset blindness among working age adults [8].

Telemedicine has decreased cost, and increased access to care in many subspecialty areas [9]. MultiplTDRS). The ADA suggests that high quality digital ime studies have been conducted to determine the feasibility of teleretinal DR screening (aging, when interpreted by an eye care professional, can serve as a valuable screening tool [2]. The technology is widely used in countries such as the UK and Australia, but less frequently in the United States. TDRS has been found to be both sensitive and specific and could be implemented widely for screening purposes [10]. On the vanguard of this movement are automated screening technologies using artificial intelligence and crowd-sourced image reading utilizing an Amazon based platform [11,12].

While much information exists on the feasibility of telemedicine, a search of the literature found very few studies comparing the rates of screenings before and after the implementation of such screenings in a private practice setting. Successful large scale implementation of TDRS has been accomplished in the Veterans Health Administration and the Indian Health Service as well as County-wide safety-net systems [13–16]. The authors hypothesized that providing a point of service TDRS at the time of an endocrinology visit in a private practice setting would increase DR screening rates and provide prompt referral for ophthalmology care in cases of severe retinopathy.

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Materials and methods

In this study, we examined the effects of a pilot program using point of service TDRS as the primary intervention to drive screening rates of patients with diabetes managed by clinicians at the Springfield Clinic (SC) Diabetic Wellness Center. The study protocol was approved, including a waiver of patient consent, by the Springfield Committee for Research Involving Human Subjects (SCRIHS), the institutional review board of the Southern Illinois University School of Medicine (SIU SOM).

A retrospective repeat pre-post intervention longitudinal study was conducted on a private endocrinology practice using TDRS as the primary intervention. Compliance rates for diabetic retinal screening were compared between December 31, 2016 and December 31, 2018. The primary intervention (TDRS) was implemented in the first week of June 2017. All active patients 18 years of age or older with a diagnosis of diabetes in both study years among five endocrinology providers at the SC Diabetic Wellness Center were included in the study. Active patients were defined as having a visit on record in both 2016 and 2018. A total of 3479 patients were included in the study.

As this study was longitudinal in nature with paired historical controls, Mcnemar's test for paired nominal data was used to compare retinal screening rates pre and post the TDRS intervention and showed a statistically significant positive effect on screening rates post implementation of TDRS ($p = < 0.004$) (Table 2). A secondary analysis was also performed to characterize those patients that were screened by TDRS intervention. The SC information technology team abstracted data from electronic medical records of patients with diabetes seen at SC.

Endocrinology providers had the option of ordering TDRS for any patient who did not have a dilated eye exam documented in electronic health record in the past 12 months at the time of endocrinology encounter. No appointment was necessary, and TDRS was performed as point of service intervention on the patient during the same day. Upon implementation of the TDRS intervention, trained staff members would obtain the fundus photo on the Topcon TRC-NW400 series automated retinal camera. The topcon camera is Digital Imaging and Communications in Medicine standard (DICOM) compliant, and is non-mydriatic and self focusing camera. The fundus images are then uploaded in the SC PACS system to be read by an ophthalmologist. Once the read is entered, the report is sent back to the ordering physician, appropriate referrals are made for follow up, and the patient's chart is updated to include the retinal image read and tagged as having met the Healthcare Effectiveness Data and Information Set (HEDIS) requirement electronically.

To evaluate rates of screening for DR, the number of patients with diabetes over the age of 18 that were compliant with retinal screening were compared pre and post TDRS intervention using encounter data. Data collected on these patients included gender, age, payer (commercial, Medicare, Medicaid), diabetes retinal screening status, and results of retinal screening.

Results

Baseline clinical characteristics and demographic data were obtained from the medical record, including age, sex, insurance carrier, and screening date. This information was later used to compare the data of the group as a whole with the TDRS group (Table 1). A two tailed T-test was used to compare age and a Z-test was used to compare insurance status and gender between the TDRS group and the population. The patient's screened with TDRS were younger with a mean age of 54 ($p < 0.001$) and were also more likely to have commercial insurance ($p < 0.001$) and to have a male gender ($p = 0.002$) than the general population. There was no significant difference in terms of patients without insurance between the groups. Retinal screening rates were compared between December 31, 2016 (pre-intervention) to December 31, 2018 (post intervention). The rollout of TDRS began in the first week of June 2017.

As of December 2018, a total of 6958 eye exams were documented for the years 2016 and 2018. Only patients who were seen by the Springfield endocrinologist in both 2016 and 2018 and had a diagnosis of diabetes in both years were included.

Overall annual screening rates for DR improved from 1964 of the 3479 patients (56.5%) pre intervention (year 2016) to 2064 of the 3479 patients (59.3%) post intervention (year 2018). One hundred fifty three eye exam in year 2018 were completed via TDRS. Mean age for screening was 54.1 years, with a greater number of male patients screened (Male = 91, Female = 62). Among the 153 TDRS patients, 85 screened negative and were advised to rescreen in 1 year and 45 were screened positive and were referred to optometry or ophthalmology (Table 3). Non-urgent referral accounted for 37 patients. These diagnoses included mild to moderate non-proliferative diabetic retinopathy (NPDR), epiretinal membrane, choroidal nevus, hypertensive retinopathy, glaucoma suspect, and myopic changes. Eight patients who screened positive for sight-threatening eye disease such as hollenhorst plaque, branch retinal artery occlusion, severe NPDR, proliferative diabetic retinopathy (PDR), diabetic macular edema, and age related macular degeneration (AMD) of unknown status, were urgently referred

Table 1
Descriptive statistics.

	2018 Population	TDRS Group	P-Value
Total Number	3479	153	
Mean Age	61.17 (STD14.23)	54.01 (STD 13.98)	< 0.001
Sex			
Male	1639 (47.11%)	91 (59.48%)	0.002
Female	1840 (52.9%)	62 (40.52%)	0.002
Insurance			
Commercial	1468 (42.2%)	86 (56.21%)	0.001
Medicare	1820 (52.31%)	45 (29.41%)	< 0.001
Medicaid	171 (4.91%)	22 (14.38%)	< 0.001
Uninsured	20 (0.57%)	0	0.35

Table 2
McNemar's Chi-squared Data Table.

The McNemar's Chi-squared below was used to find a nearly 3% increase in screening rates between 2016 and 2017. This was statistically significant with a p value of 0.004. The compliance rate increased from 56.5% (1964 patients) to 59.3% (2064 patients)

	Screened in 2016	Unscreened in 2016	Total
Screened in 2018	1419	645	2064
Unscreened in 2018	545	870	1415
Total	1964	1515	3479

Table 3
TDRS screening results.

Total screened	153
Negative	85 (55.56%)
Mild NPDR	13 (8.5%)
Moderate NPDR	5 (3.27%
Severe NPDR	1 (0.65%)
DME *included in one retinopathy categories as well	1 (0.65%)
Total Diabetic Positive Screening	19 (12.4%)
No Diabetic Findings, But Other Pathology Found	34 (22.2%)
AMD	6 (3.92%)
ERM	3 (1.96%)
Choroidal Lesion/Nevus	4 (2.61%)
Hypertensive retinopathy	10 (6.54%)
Glaucoma suspect	7 (4.58%)
Scars	2 (1.31%)
Peripapillary atrophy	2 (1.31%)
Poor quality images	23 (15.03%)

(Percentages will not equal 100 as some fall into multiple categories).

for ophthalmological follow up. TDRS technical failure rate was 15%, and was primarily secondary to technician familiarity with camera use. The 23 screening failures were referred to optometry for an eye exam. Overall 12.4% of patient's screened with TDRS screened positive for some form of diabetic eye disease requiring evaluation with eye care professional. The majority of these positive screenings were for mild non-proliferative diabetice retinopathy (8.5%). Interestingly, 22.2% of patients had positive screenings for other pathologies. Overall 53 patients (34.6%) of patients were referred to eye care professionals secondary to some form of ocular pathology screened with TDRS.

One of the limitations with the present system is that our clinic does not have ICD-10 codes associated with disease severity of the patients seen at outside providers. Hence we cannot provide comparative statistics on disease severity for the year 2016 or the portion of the 2018 group screened by eye care professionals outside of TDRS. This reflects one of the shortcomings of the current system in place. Since the population is largely screened by small practice providers outside of our system their paper exams are scanned into our system. The scanned exam is part our EHR but the ICD-10 codes reflecting their disease severity does not transfer electronically.

Discussion

TDRS is an effective tool in a private practice setting. It significantly increased the rate of diabetic screening in the present study. This mirrors studies from other patient populations that showed improved screening rates [16,17]. However, the intervention only increased screening rates in our private practice by 3% which although significant is a smaller increase as compared to prior studies in other populations. What may account for some of this change is baseline under reporting of screening rates. The eye care profession in Springfield, IL as in much of the United States is fragmented with multiple small independent optometry and ophthalmology practices. SC is a vertically integrated medical practice offering a wide array of patient care and support services ranging from internal medicine to endocrinology, podiatry, optometry and ophthalmologic practices to name just a few of the specialties included. Although SC is vertically integrated it does works with smaller independent optometric practices to ensure screening of patients with diabetes happens on at least an annual basis. SC is reliant upon these independent providers to communicate exam findings and for those findings (often submitted on paper) to be flagged as meeting the HEDIS requirement in our electronic health record (EHR). There are several steps in this process with the paper documents physically scanned and the IT department updating the EHR. All of this may contribute to baseline under reporting of actual compliance with the HEDIS requirement. This was consistent both pre and post intervention, so we attribute the additional screenings in 2018 to the patient's screened using TDRS. Which is also borne out through the actual number of patients screened with TDRS (153 patients) being very similar to the increase in total number of screened patients in 2018 as compared to 2016 (100 patients).

It is of interest that the TDRS group had a larger amount of commercial payers and lower number of medicare patients as compared to the entire population. We hypothesize that commercially insured patients in our practice tend to be insured through an employer and since they are of working age, they may have less time to schedule a second visit with an eye care professional. Hence the onsite retinal screening is convenient for these patients and it is reflected in their over representation in the TDRS group.

Tele retinal Medicine screening codes were used to bill the service, specifically 92,227 and 92228. 92,227 is a screening code for patients with unknown diabetic status. 92,228 is a teleretinal fundus image code to monitor known retinal disease. The RVU value associated with 92,227 is 0.41 compared to 92,228 which is 1.06 as compared to 92,250 (fundus photography) which is 2.39. This translates to medicare reimbursements of $15.30 for 92227, $35.85 for 92228, and $59.77 for 92250.

In addition to low rate of reimbursement 92,227 is also a code that cannot be split between a professional and technical component meaning the code could only be assigned to the reading ophthalmologist or ordering endocrinologist, and Medicare has a policy of not paying for screening tests which meant 92,227 could be summarily rejected for reimbursement by some insurers including Medicare [18].

There are several reasons for the lower rate of adoption of TDRS in our study. Our real-world private practice model links provider compensation to productivity. Endocrinology providers using TDRS were being reimbursed at a significant lower reimbursement rate compared to the traditional eye exams and were at risk for payments being rejected by medicare as the retinal testing could be considered a screening exam as described above. Also, in a busy private practice, each patient is allocated 15–20 min for a follow up visit and having the tele retinal exam added an additional 8 min to the patients follow up appointment and the nursing staff time drawn from other tasks. And finally, some patients preferred a traditional more comprehensive eye exam and opted for a local eye care professional. A survey of the providers present during the study confirms these reasons for the lower uptake than would be expected from other teleretinal medicine studies (Fig. 1).

Despite the above drawbacks, TDRS proved modestly effective even in our model. Insurers and other large stakeholders in health policy should consider ensuring appropriate reimbursements for TDRS on par with the traditional eye exams and this would enhance further adoption.

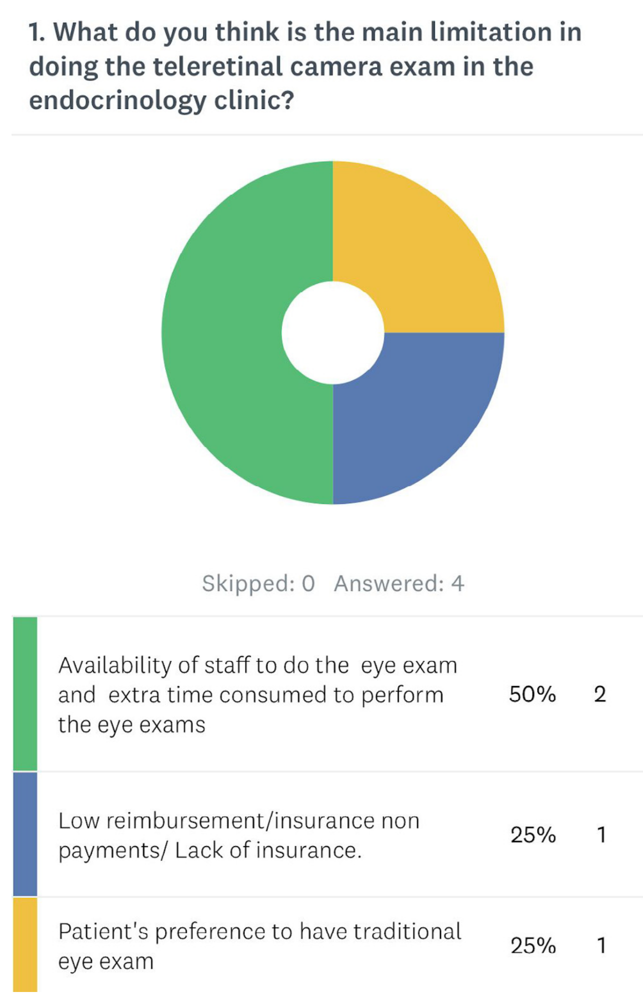

Fig. 1. Survey of Providers Regarding Limited Uptake of TDRS.

Conclusion

There is no argument that TDRS is an effective way to increase access to care and patient convenience in our resource strapped system with a new focus on quality of care. However, as our real world private practice model reveals there are multiple rate-limiting factors to the implementation of TDRS. Much of the barrier lies with how telemedicine in general is reimbursed by insurers. Although there is little question that screening reduces disease burden and cost and TDRS is an effective means to expand screening, insurers have not yet come on board by incentivizing the behavior in the U.S. healthcare system. Once this occurs TDRS is poised to grow exponentially. The authors believe it is only a matter of time before telemedicine will become more accepted across society in the U.S. and become a mainstay of diabetic retinal care.

CRediT authorship contribution statement

Chaitanya K. Mamillapalli: Conceptualization, Methodology, Writing - original draft. **Jessi R. Prentice:** Software, Formal analysis, Writing - review & editing, Data curation. **Arvind K. Garg:** Writing - review & editing, Visualization. **Sunny L. Hampsey:** Formal analysis, Investigation. **Ramanath Bhandari:** Supervision, Project administration, Writing - review & editing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcte.2019.100214.

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