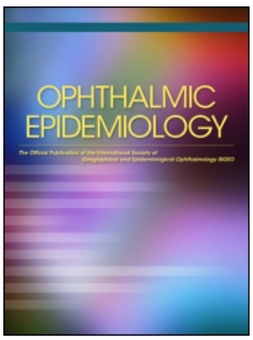

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Ophthalmic Epidemiology

ISSN: 0928-6586 (Print) 1744-5086 (Online) Journal homepage: https://www.tandfonline.com/loi/iope20

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To cite this article: Leonardo Mastropasqua, Roberto Perilli, Rossella D'Aloisio, Lisa Toto, Alessandra Mastropasqua, Simone Donato, Merilda Taraborrelli, Federica Ginestra, Massimo Porta & Agostino Consoli (2020): Why Miss the Chance? Incidental Findings while Telescreening for Diabetic Retinopathy, Ophthalmic Epidemiology, DOI: 10.1080/09286586.2020.1715450

To link to this article: https://doi.org/10.1080/09286586.2020.1715450

Published online: 20 Jan 2020.

OPHTHALMIC EPIDEMIOLOGY
https://doi.org/10.1080/09286586.2020.1715450

Why Miss the Chance? Incidental Findings while Telescreening for Diabetic Retinopathy

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ABSTRACT

Purpose: To report on incidental pathological findings met while screening for Diabetic Retinopathy (DR) in Diabetes Clinics (DC) by ophthalmologist-graded digital fundus imaging.

Methods: At the DC of Pescara (central Italy), for 3,859 eyes of 1,930 consecutive patients having not undergone fundus examination in the last year, two mydriatic fundus digital images, taken with a CenterVue DRS Digital Retinal Camera, were sent along with Best Corrected Visual Acuity, on a "store-and-forward" basis, to an ophthalmologist trained in DR screening, and graded according to the UK Diabetic Eye Screening Programme. Incidental fundus abnormalities other than DR were reported.

Results: No adverse event to mydriasis was reported. One hundred and eighty eyes (4.66%) were ungradable. Among the 3,679 gradable ones, 1,105 (30.04%) showed different degrees of DR (R1 to R3), and 126 (3.42%) maculopathy (M1). Any Age-Related Macular Degeneration was present in 387 eyes (10.52%), any optic disc and parapapillary area features suspect for glaucoma in 562 eyes (15.27%), any hypertensive retinopathy in 1,263 eyes (34.33%), vitreoretinal interface disease in 252 eyes (6.84%), myopic choroidopathy in 92 eyes (2.50%), disc pallor in 31 eyes (0.84%). Mean time was 5 min for screening, 2 min for grading.

Conclusion: Teleretinography is a well-established, cost-effective procedure in DR screening. Along with increased attendance, locating a digital camera in a DC with a retina-specialist grader results in finding fundus pathologies also beyond DR, very similarly to fundus examination in an outpatient ophthalmic setting.

ARTICLE HISTORY
Received 20 October 2019
Revised 19 December 2019
Accepted 7 January 2020

KEYWORDS
Telemedicine; teleretinography; fundus imaging; diabetic retinopathy; age-related macular degeneration; glaucoma; vitreoretinal interface disease

Introduction

Diabetes Mellitus (DM) is a common and rapidly increasing disease[1] and a main cause of blindness worldwide.[2] Diabetic retinopathy (DR) is both a frequent complication[3,4] and a marker of disease control[5] extremely useful to diabetologists, but the attendance of diabetic patients to periodical fundus examination is universally low,[6,7] although the need for screening programmes has been stated long since.[8]

Therefore, the application of telemedicine to DR screening by remote digital fundus images evaluation[9-11] has revolutionized both the attendance to screening[12] and the natural history of such complication,[13] allowing a better knowledge of DM course and early identification of DR, amenable to treatment resulting in a strong decrease in DR-related blindness. In his review of the results of the English National Screening Programme for DR in the years 2003–2016, Scanlon[12] reported a decrease in prevalence of certifiable blindness from 4,200 to less than 1,000, and the finding that DR was no more the leading cause of certifiable blindness amongst working age adults in UK. In England, a well-established DR screening strategy, recognized as one of the 15 essential health-care checks by Diabetes UK, produced outstanding results: between 1 April 2017 and 31 March 2018, 2,700,774 people with DM were offered eye screening, 2,232,797 people were screened, 63,675 people were referred for follow-up tests or treatment; every year, around 7,000 people with sight-threatening diabetic retinopathy are referred to hospital eye services for urgent treatment.[14] The positive effect of screening patients in a Diabetes Clinic on attendance and early diagnosis of DR has been reported by Roser.[15] Such efforts meet the priorities reported in the National Eye Institute – National Eye Health Education Program Five-Year Agenda 2012–2017 (at nei.nih.gov/nehep): "Research has shown that early diagnosis and timely treatment can prevent vision loss in more than 90% of people with diabetes, yet approximately half of all people with diabetic

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retinopathy are diagnosed at a stage when it is too late for treatment to be effective".

Nowadays, longer life expectancy in DM causes an increase in age-related and sight-threatening eye diseases (Age-Related Macular Degeneration – ARMD, primary open-angle glaucoma – POAG), and a prolonged effect in pathologies in which DM acts as a contributory cause: Jeganathan[16] reported clinical fundus pictures associated with DM as a cause (anterior ischemic optic neuropathy, diabetic papillopathy), a recognized risk factor (open-angle glaucoma, neovascular glaucoma, ocular ischemic syndrome) or a possible risk factor (retinal vein occlusion, retinal artery occlusion).

As such conditions (and others not related to DM, like choroidal naevi and melanomas) involve the posterior pole, well targeted by teleretinography, we tested the opportunity both of adding screening for other eye conditions to screening for DR, and of putting an ophthalmologist in charge of grading DR, capable of identifying early stages of other retinal/optic nerve diseases too.

In reporting the UK initiatives in screening for DR and detection of glaucoma, macula disease, emergency eye disease in 2016, Sim[17] concluded that "The use of teleophthalmology presents an immense opportunity to manage the steadily increasing demand for eye care, but challenges remain in the delivery of practical, viable, and clinically proven solutions". This paper aims to show how eye care opportunities can be increased and delivery challenges reduced with affordable "practical, viable and clinically proven solutions".

Materials and methods

Since 2017, at the Diabetes Clinic of the University of Chieti-Pescara Chair of Endocrinology, patients needing guideline-suggested yearly fundus examination are routinely offered digital photography during a scheduled diabetes check instead of a clinical outpatient exam, aiming to increase patients' attendance, very low in Italy (8.2% according to the 2019 ARNO report, at www.arno.cineca.it).

Since September 1st, 2017, to October 19, 2019, 1,930 consecutive diabetic patients choosing digital eye examination (Males = 1047, Females = 883, aged 18 to 90) participated in the present study. Patients repeating retinography during the study period were considered only once, to avoid duplicating incidental findings.

While accessing the Clinic for scheduled exams, patients underwent best-corrected visual acuity (BCVA) examination with an ETDRS chart, external ocular examination and pupil dilation with one drop of Tropicamide 1% (Visumidriatic 10%, Visufarma, Italy), by an orthoptist (screener) trained in grossly evaluating anterior chamber's depth with lateral illumination and in recognizing signs and symptoms of intraocular pressure (IOP) elevation after mydriasis. A pair of 40x45° fundus images, one centered at the fovea and the other at the optic disc, were taken for each eye with a DRS digital retinal camera (CenterVue, Padova, Italy). Patients were informed on how to recognize and report symptoms and signs of IOP elevation, and sent back to continue their scheduled check in the Clinic. Based on a "store-and-forward" model, both images and BCVA for each patient were sent to a server, to be periodically downloaded in a territorial ophthalmic facility by an ophthalmologist (RP), specifically trained in the UK-model DR screening (www.gov.uk/health-and-social-care/population-screening-programmes-diabetic-eye) by achieving a Certificate of Higher Education in Diabetic Retinopathy Screening by the University of Gloucestershire (www.drscreening.org). Images were graded according to the UK NHS Diabetic Eye Screening Programme (DESP) standards[18,19] (Table 1), accordingly considering BCVA ≤ 6/12 (in the absence of other causes) as a surrogate marker for macular edema; grading, incidental findings, and clinical suggestions were reported into a specific Electronic Health Record (EHR: Smart Digital Clinic, Meteda, San Benedetto del Tronto, Italy), thus being immediately available to both diabetologists and primary care physicians (via a dedicated software connecting the EHR to each one's personal computer: QUICKConnect, opeNETica, Montesilvano, Pescara, Italy). Urgent cases (DR and others), as well as patients needing instrumental exams or surgical/laser therapy were sent to the Excellence Center in Ophthalmology at the University of Chieti-Pescara in an accordingly short time.

The ophthalmologist classified incidental findings according to:

- ARMD: AREDS 2001, in AAO Preferred Practice Patterns: Age-Related Macular Degeneration[20] (Table 2);
- Glaucoma suspect: Ocular Hypertension Treatment Study,[21] European Glaucoma Society[22] (Table 3). As the present paper concerns screening, only patients satisfying the parameters of glaucoma suspect were included, while confirmation was obtained by a second-level facility and not reported herein;
- Hypertensive Retinopathy: Keith-Wagener-Barker[23] (Table 4).

Descriptive classifications were provided for pathologies incapable of being classified correctly enough by

Table 1. Diabetic Eye Screening Programme definitions for diabetic retinopathy.[18,19]

Grade (Retinopathy)	Retinal lesions
R0 (None)	None
	Isolated (one or more) cotton wool spots (CWS) in the absence of other features of DR
R1 (Background)	Microaneurysm(s)
	Haemorrhage(s)
	Any exudate in the presence of other features of DR
	Any number of cotton wool spots (CWS) in the presence of other features of DR
	Venous loops
R2 (Preproliferative)	Venous beading (venous beading from ischaemia in diabetic retinopathy does not occur in isolation from multiple blot haemorrhages or IRMA)
	Venous reduplication
	Intraretinal microvascular abnormality (IRMA)
	Multiple blot haemorrhages
	(if uncertain, refer only in the presence of IRMA that are definitely seen)
R3S (Stable proliferative post-treatment)	Stable pre-retinal fibrosis + peripheral retinal scatter laser
	Stable fibrous proliferation (disc or elsewhere) + peripheral retinal scatter laser
	Stable R2 features (from feature based grading) + peripheral retinal scatter laser
	R1 features (from feature based grading) + peripheral retinal scatter laser
R3A (Active proliferative)	New vessels on disc (NVD)
	New vessels elsewhere (NVE)
	New pre-retinal or vitreous haemorrhage
	New pre-retinal fibrosis
	New tractional retinal detachment
	Reactivation in a previous stable R3S eye
Grade (Maculopathy)	Macular lesions (the macula is defined as that part of the retina which lies within a circle centred on the centre of the fovea whose radius is the distance between the centre of the fovea and the temporal margin of the disc)
M0 (No maculopathy)	None
	Any microaneurysm or haemorrhage within 1 disc diameter (DD) of the centre of the fovea if associated with a best visual acuity (VA) of ≤ 6/12 where the cause of the reduced vision is known and is not diabetic macular edema
M1 (Maculopathy)	Exudate within 1 DD of the centre of the fovea
	Group of exudates within the macula: a group of exudates is an area of exudates that is greater than or equal to half the disc area and this area (of greater than or equal half the disc area) is all within the macular area
	Retinal thickening within 1 DD of the centre of the fovea (if stereo available)
	Any microaneurysm or haemorrhage within 1 DD of the centre of the fovea only if associated with a best VA of ≤ 6/12 (if no stereo)

Table 2. Grading definitions for age-related macular degeneration.

NO	No or few small drusen (<63 micron)
Early	A combination of multiple small drusen, few intermediate drusen (63–124 micron in diameter), or mild RPE (retinal pigment epithelium) abnormalities
Intermediate	Numerous intermediate drusen
	At least one large druse (≥125 micron in diameter)
	Geographic atrophy (a sharply demarcated, usually round or oval, area of atrophy of the RPE not involving the center of the fovea)
Advanced	Geographic atrophy of the RPE involving the foveal center
	Neovascular maculopathy that includes the following:
	• choroidal neovascularization (defined as pathologic angiogenesis originating from the choroidal vasculature that extends through a defect in Bruch's membrane)
	• serous and/or hemorrhagic detachment of the neurosensory retina or RPE
	• retinal hard exudates (a secondary phenomenon resulting from chronic intravascular leakage)
	• subretinal and sub-RPE fibrovascular proliferation
	• disciform scar (subretinal fibrosis)

Table 3. Definitions for glaucoma suspect.

- Cup/Disc ratio (increasing risk ≥0.3, depending on disc size)
- Cup/Disc ratio asymmetry (≥0.2)
- Disc haemorrhages
- Parapapillary atrophy
- Bending, bayoneting or baring of circumlinear vessels
- Myopic tilted discs
- Irregular ISNT (Inferior-Superior-Nasal-Temporal) nerve fiber layer distribution
- Neuroretinal rim: diffuse narrowing and/or localized notching

means of ophthalmoscopy alone (e.g. Vitreo-Retinal Interface Abnormalities – VRIA).

Patients released informed consent for both the procedure and the personal data management according to the General Data Protection Regulation (European Union Regulation 2016/679). Patients' data were anonymized. Whatever health and safety aspect related to the procedure was complied. This study followed the principles of the

Table 4. Keith–Wagener–Barker classification of hypertensive retinopathy.[23]

Grade	Features
I	Mild generalized retinal arteriolar narrowing
II	Definite focal narrowing and arteriovenous nipping
III	The above and retinal haemorrhages, exudates and cotton-wool spots
IV	Severe grade III and papilloedema

Declaration of Helsinki and was authorized by the Ethical Committee of the University of Chieti-Pescara.

Results

No adverse event to mydriatic drops was recorded. One eye was excluded owing to phthisis bulbi.

Out of the remaining 3,859 eyes, 180 (4.66%) were ungradable, and patients were sent to the ophthalmic facility for clinical examination. These eyes were excluded from the total sample. Among the remaining 3,679 eyes, 1,105 (30.04%) showed different degrees of DR (R1: 840 eyes, 22.83%; R2: 111 eyes, 3.02%; R3A: 9 eyes, 0.24%; R3S: 145 eyes, 3.94%) and 126 showed maculopathy (M1, 3.42%), and patients were suggested an appropriate follow-up or intervention in accordance with the Italian guidelines for Diabetic Retinopathy (AMD-SID: Italian Standards for Diabetes Care 2016, at www.standarditaliani.it).

As for incidental findings, ARMD was present in 387 eyes (10.52%): early: 166 eyes (4.51%); intermediate: 173 eyes (4.70%); advanced: 48 eyes (1.30%); optic disc and/or parapapillary area features suspect for glaucoma in 562 eyes (15.27%); hypertensive retinopathy (degrees 1–2) in 1,263 eyes (34.33%:); VRIA in 252 eyes (6.84%), choroidal naevi in 53 eyes (1.44%); any form of venous occlusion in 19 eyes (0.51%); myopic choroidopathy in 92 eyes (2.50%): optic disc pallor without signs of glaucoma suspect in 31 eyes (0.84%).

1,336/1,926 patients (69.36%) reported systemic anti-hypertensive therapy and 119/1,823 (6.52%) topical anti-glaucoma therapy. Not all patients were sure to remember to suffer or not from arterial hypertension or glaucoma.

For each patient, BCVA measurement plus image taking lasted from 4 to 7 min (mean: 5), and grading from 1 to 3 min (mean: 2).

Discussion

Chen[24] reported DM acting as a risk factor for ARMD, stronger for late than earlier stages. Chew[25] stressed the impending diffusion of ARMD in the near future, stating that the number of individuals with AMD globally will approach 196 million in 2020 and 288 million by 2040, and evidenced the cost-effectiveness of adding the ARMD screening to the DR one. Our high-ranking percentage (all stages 10.52%) confirms the utility of such opportunity. Periodical screening for ARMD even in asymptomatic patients has provided positive results yet.[26] The recent observations by Hallak et al.[27] that total en face area of drusen in a circular area 3 mm from the fovea is associated with conversion to the wet form, and by Domalpally et al.[28] that reticular pseudodrusen have an increased risk of progression to geographic atrophy, further stress the importance of fundus imaging in early diagnosis. In a recent paper on a remote diagnosis imaging model, Hadziahmetovic[29] concluded that "Good operational characteristics found in this study suggest the feasibility of using this model to screen and refer patients to a retinal specialist".

POAG – another leading cause of blindness worldwide[2] – affects an estimated 2.2 million people in the United States, and that number is likely to increase to 3.3 million in 2020 as the population ages,[30] facilitated by the fact that it often goes undetected due to the absence of warning symptoms or signs in the early stages. It is accepted that diabetic patients undergo POAG more frequently than the general population,[31] and our percentage of patients in glaucoma therapy (6.52%) seems to support such finding. Gangwani[32] reported an overall prevalence of 1.8% for confirmed glaucoma in the population of diabetic patients screened, identifying an abnormal (>0.6) cup/disc ratio (CDR) in 3.7% of 2,182 patients undergoing a DR screening. Ong[33] reported 216 (1.9%) fundus-images based glaucoma suspect out of 11,565 patients undergoing the UK DR screening in 2006–2008. As for the problem of monoscopic (proper of DR screening) versus stereoscopic evaluation of the optic disc, Myers[34] reported two studies[35,36] showing a satisfactory interobserver expert agreement in evaluating the CDR and other glaucomatous characteristics, and Newman-Casey[37], reviewing studies about monoscopic photography in glaucoma screening, reported that differences in sensitivity and specificity against both dilated fundus examination by an ophthalmologist and stereoscopic photography are not striking, stating that monoscopic digital photography could be an important component of glaucoma assessment, capable of being provided at the primary care level too. Our high-ranking percentage of glaucoma suspects (15.27%) is likely due to considering each and every sign of suspect disc and parapapillary area (Table 3), and not only the vertical CDR, thus stressing the advantage of an ophthalmologist grading DR images and finding

comorbidities (or suspects). Verifying how many glaucoma suspects turned into glaucoma patients was not an aim of the present study.

Vitreoretinal interface[38] is a leading factor in interpreting and treating diabetic maculopathy as well as other pathologies like vitreomacular traction or macular hole, and its abnormalities (VRIA) are more frequent in diabetic eyes.[39] VRIA are finely diagnosed by OCT, but fundus images allow diagnosis of some presentations: in a UK experience,[40] photography allowed diagnosing epiretinal membrane (ERM) and full-thickness macular hole, but missed other forms of VRIA needing OCT for diagnosis: vitreomacular traction at the fovea or elsewhere, partial thickness macular hole, and foveoschisis. A review by Xiao[41] stressed the variability in grading different kinds and stages of ERMs, but reported an overall usefulness of monoscopic photography. Our percentage (6.84%) is not far from the overall incidence of 8.4% (cellophane macular reflex + preretinal macular fibrosis) in 2,476 electronically imaged patients examined by Yang,[42] who attributes to diabetes (defined as fasting plasma glucose ≥ 7 mmol/L) a 1.41 odds ratio, to DR prevalence a 1.39 odds ratio, and to DR stage an 1.13 odds ratio in VRIA development.

Long[43] reported that up to 75% of people with DM have arterial hypertension (69.37% of our patients reported antihypertensive therapy), and it is well known that hypertension has long been followed up by fundus examination too. In hypertensive retinopathy, fundus examination is a well-established diagnostic mainstay (https://eyewiki.aao.org/Hypertensive_retinopathy), with some doubts emerging in the last years related to its value as a marker of cardiovascular risk in elder people[44]. We found 34.33% of eyes showing grades 1–2 of the Keith–Wagener–Barker's classification.

Other pathologies that can be reported in DR screening are: retinal vein occlusion (RVO, prevalence: 0.5-2% for branch RVO and 0.1–0.2% for central RVO; estimated 15-year incidence rate: 1.8% for branch RVO and 0.2% for central RVO[45]); central retinal artery occlusion (incidence: 1/100,000[46]); non-arteritic anterior ischemic optic neuropathy (annual incidence: 2.3–10.2/100,000 in the USA[47]); arteritic anterior ischemic optic neuropathy (5–10% of all anterior ischemic optic neuropathies[48]); diabetic papillopathy (prevalence: 1.4% in diabetic patients[49]); signs of optic neuritis in multiple sclerosis patients (initial presentation in ~20% of patients, potentially occurring during the course of the disease in 50% of patients[50]); choroidal naevi (prevalence in USA adults aged > 40: 5%[51]); choroidal melanoma (overall incidence in the USA: 5/.1,000,000[52]). Among all these, we reported 17 eyes with any form of venous occlusions (0.48%) and 39 eyes with posterior pole choroidal naevi (1.10%); other fundi amenable of clinical diagnosis were the 35 (0.98%) showing optic disc pallor not suitable of being glaucoma suspects and the 92 (2.50%) showing myopic choroidopathy: both categories were sent to the ophthalmic facilities owing to the possibility of systemic or ocular complications.

Two more advantages of screening performed by an ophthalmologist concern population eye needs assessment.

Consider the suggested periodicity of eye examinations in a general population. The American Academy of Ophthalmology (AAO) Preferred Practice Pattern Diabetic Retinopathy[53] suggests that "People with Type 1 diabetes should have annual screenings for diabetic retinopathy beginning 5 years after the onset of their disease, whereas those with Type 2 diabetes should have a prompt examination at the time of diagnosis and at least yearly examinations thereafter"; the AAO Preferred Practice Pattern Comprehensive Adult Medical Eye Evaluation[54] states: "The suggested fundus examination periodicity for people with no risk factors is: under 40: 5–10 years; 40–54: 2–4 years; 55–64: 1–3 years; 65 or older: 1–2 years (for all classes: moderate quality, strong recommendation). For people with risk factors for glaucoma: 1–3 years for 40–54, 1–2 years for others, depending on the ophthalmologist's judgement (for all classes: moderate quality, strong recommendation)". Plotting the above recommendations suggests that undergoing yearly DR telescreening in people otherwise free of ocular symptoms and signs provides patients with the opportunity of a frequent fundus examination (in younger age classes even more frequently than suggested), thus allowing an early identification of whatsoever pathologic findings in the posterior pole and glaucoma suspects.

Moreover, telescreening can strongly contribute in building up a whole integrated care path for DR involving primary care providers (PCPs). Liu et al.[55] reported that their recommendations to diabetic patients to undergo teleretinal screening are, along with convenience (e.g., same-day scheduling, location, being a quick procedure) and comprehension of the importance, the most important facilitator to participate in screening initiatives. From the PCPs' viewpoint, the main facilitators to join a screening initiative were ease of referral process and results communication, perceived benefits to patients (e.g., convenience, cost), improved adherence, benefits to health-care organization (e.g., increased reimbursement for improved quality metrics). PCPs nevertheless play a central role in motivating citizens to take care of their own eyes, what they often neglect by themselves: a 2016 UK Royal

National Institute for the Blind survey (available at www.rnib.org.uk/stateofthenation) evidenced that 27% of the general population aged 18 and above had not undergone even a simple sight test in the last two years. This confirms that citizens frequently do not attend scheduled ophthalmic examinations, thus often missing the early diagnosis of potential causes of low vision and blindness. Obvious consequences both on each one's health (not only eye health, as low vision strongly affects quality of life,[56,57] is a factor in falls and fall-related fractures[58] and a cause of depression[59,60]), and on the nations' social security systems result from such health literacy weakness.

There is a long-standing debate about who should be a grader (trained nonprofessional, optometrist, orthoptist, family physician, diabetologist, ophthalmologist), with recent encouraging results provided by optometrists supervised by retina specialists.[61] In view of the above considerations, and along with both Boucher[62] (reporting a much longer than ours series of incidental findings), and the AAO Telemedicine Statement[63] (point F – Reading: "An ophthalmologist or team of image readers under ophthalmologist supervision should perform image grading, image reading with recommendations, and results reporting."), we believe that an ophthalmologist (better, a retina specialist, as shown for DR[64]) can identify not only DR but each and every incidental finding, and collaborate with neurologists to identify risk factors for cerebrovascular disease[65,66] and microvascular findings related to cognitive impairment.[67] A non-ophthalmologist undergoing both an accurate training for DR-specific and other types of retinal/optic nerve abnormalities, and a strict quality assurance control (as in the UK Diabetic Eye Screening Programme), could act as a first grader in identifying normal/any abnormal images.

With a retina-specialist examining images, our percentages in reporting pathological findings are slightly higher than those reported by Park and Mansberger,[68] possibly owing to different population and methodology characteristics (undilated patients, only vertical C/D ratio for glaucoma suspect, training of graders), and strongly support their findings that one in four eyes had at least one eye disease, and that 17% of eyes had diseases other than DR, thus confirming the necessity to widen the diagnostic spectrum when examining fundus images.

In our experience, we gave DR screening the meaning of providing diabetologists with a tool to monitor the disease, as it happened and still happens when the diabetologist him/herself examines the posterior pole by direct ophthalmoscopy, thus making fundus examination diabetologist-oriented more than ophthalmologist-oriented. Such pathway completely satisfies both the Wilson and Jungner's[69] and the Andermann's[70] criteria for screenings, excellently adapted to DR by Das.[71]

Comparing our results (in terms of: patients' uptake; screening worktime – about 5 min for the screener, about 2 min for the grader for each patient; time between screening, grading and results' availability in the EHR; timeliness of referral to ophthalmic facilities for a thorough diagnosis and therapy) to the setting of outpatient clinical fundus examination, suggests that shifting fundus examinations for DR from the ophthalmic outpatient to the in-the-Diabetic-Clinic teleretinography setting, could become a cost- and health-effective procedure, with the side effect of "not to miss the chance" both to identify incidental findings and to improve health literacy (making patients aware of their pathologies and suggesting them to undergo regular complete eye examinations).

The "World Health Organization Universal Eye Health: a Global Action Plan 2014–2019" (who.int/blindness/actionplan/en/) states that – Developing and implementing national policies and plans for the prevention of avoidable visual impairment remain the cornerstone of strategic action. Some programmes against eye diseases have had considerable success in developing and implementing policies and plans, however, the need remains to integrate eye disease control programmes into wider health-care delivery systems, and at all levels of the health-care system. In increasing numbers, countries are acquiring experience in developing and implementing effective eye health services and embedding them into the wider health system. These experiences need to be better documented and disseminated so that all countries can benefit from them. Operational research will provide evidence on ways to overcome barriers in service provision and uptake, and improvements in appropriate cost-effective strategies and approaches for meeting ever-growing public health needs for improving and preserving eye health in communities.

Thus, each effort to make citizens' access to health easier and to improve literacy is a holy one, and teleretinography, as above discussed, has all the characteristics to be a preeminent one, helping to bring fundus examination to patients instead of waiting for patients to attend an outpatient ophthalmic facility.

Declaration of interest statement

None of the authors have whatsoever financial interest in this study.

Financial support

No financial support was provided.

Disclosure of interest

None of the authors have any proprietary interest or conflict of interest related to this submission.

Publication elsewhere

This submission has not been published elsewhere previously and is not simultaneously being considered for any other publication.

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