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## Short Report: Complications

# Delay in diabetic retinopathy screening increases the rate of detection of referable diabetic retinopathy

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### Abstract

**Aims** To assess whether there is a relationship between delay in retinopathy screening after diagnosis of Type 2 diabetes and level of retinopathy detected.

**Methods** Patients were referred from 88 primary care practices to an English National Health Service diabetic eye screening programme. Data for screened patients were extracted from the primary care databases using semi-automated data collection algorithms supplemented by validation processes. The programme uses two-field mydriatic digital photographs graded by a quality assured team.

**Results** Data were available for 8183 screened patients with diabetes newly diagnosed in 2005, 2006 or 2007. Only 163 with Type 1 diabetes were identified and were insufficient for analysis. Data were available for 8020 with newly diagnosed Type 2 diabetes. Of these, 3569 were screened within 6 months, 2361 between 6 and 11 months, 1058 between 12 and 17 months, 366 between 18 and 23 months, 428 between 24 and 35 months, and 238 at 3 years or more after diagnosis. There were 5416 (67.5%) graded with no retinopathy, 1629 (20.3%) with background retinopathy in one eye, 753 (9.4%) with background retinopathy in both eyes and 222 (2.8%) had referable diabetic retinopathy. There was a significant trend ( $P = 0.0004$ ) relating time from diagnosis to screening detecting worsening retinopathy. Of those screened within 6 months of diagnosis, 2.3% had referable retinopathy and, 3 years or more after diagnosis, 4.2% had referable retinopathy.

**Conclusions** The rate of detection of referable diabetic retinopathy is elevated in those who were not screened promptly after diagnosis of Type 2 diabetes.

Diabet. Med. 31, 439–442 (2014)

### Introduction

There is a strong correlation between incidence of diabetic retinopathy and duration of diabetes [1]. Detection of referable diabetic retinopathy at a patient's first screening appointment raises the following questions:

1. Could this relate to the time course of development of diabetes? Referable diabetic retinopathy around the time of diagnosis is recognized in Type 2 diabetes [2]. We know from closely monitored populations such as the Whitehall II study [3] that blood glucose rises above normal only around 18 months before diagnosis of diabetes. In populations like this who are regularly screened for diabetes, the prevalence

of diabetic retinopathy is low [4]. In those who present symptomatically with diabetes, the onset of diabetes is estimated [5,6] to be 4–7 years before diagnosis and the prevalence of retinopathy is reported to be higher [2].

2. Is this attributable to the screening programme not being informed in a timely fashion of the diagnosis? Diabetic eye screening programmes are totally reliant on general practices informing them of all newly diagnosed patients and, as this is predominantly a manual process, errors and omissions are sometimes made.
3. Is this because of the person with diabetes not attending the screening appointment? Those on the screening register are invited within 3 months of being added to the register and then annually, but may choose not to take up the invitation, or may wait for two or more years before doing so.

In order to determine whether delay in screening for diabetic retinopathy as a result of any of the above factors

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**What's new?**

- This report is the first that has described a relationship between rate of detection of referable diabetic retinopathy and delay in screening for diabetic retinopathy after diagnosis of Type 2 diabetes.
- We would like to use this report as evidence to ask for a new quality standard in UK diabetic eye screening programmes. We suggest a target be set for proportion screened within 2 years of being added to the screening register.

might be clinically important, we determined the prevalence of referable diabetic retinopathy at the first screening episode by time after diagnosis in patients attending the Gloucestershire Diabetic Eye Screening Programme (GDESP).

**Methods**

Data for patients referred to the eye screening programme were extracted from the primary care databases with

semi-automated data collection algorithms supplemented by validation processes using procedures developed under the General Practice to Diabetic Retinopathy Screening (GP2DRS) project, which was initiated as a joint initiative between the English National Health Service (NHS) Diabetic Eye Screening Programme (DESP) and Connecting for Health to automatically extract patient records from general practices. Patients were referred from 88 primary care practices and invited for screening at a local primary care practice with mobile cameras. Digital retinal images of both eyes were taken after pharmacological dilatation and graded by the quality-assured grading team. People with diabetes in this programme are routinely sent an invitation to phone to book an appointment with the screening service within 3 months of the service being informed by the general practice of the new person with diabetes and then once a year, with one reminder being sent if they do not take up the annual offer.

Data collected from the screening programme were analysed to examine the proportion with diabetic eye disease at intervals from diagnosis of diabetes. In the English NHS Diabetic Eye Screening Programme, all images are automatically allocated a retinopathy (R) grade and a maculopathy

**Table 1** Comparison between the retinopathy grading classification of the English NHS DESP and the ETDRS

English retinopathy classification (R levels—R0, R1, R2 or R3) Outcome	English Screening Programme levels	ETDRS final retinopathy severity scale	ETDRS(final) grade	Risk of progression to proliferative diabetic retinopathy in 1 year
Re-screen in 12 months	R0 (no retinopathy)	No apparent retinopathy	10, 14, 15	
Re-screen in 12 months	R1 (background retinopathy), microaneurysm(s), retinal haemorrhage(s), any exudate	Mild non-proliferative retinopathy	20–35	6.2%
Routine referral to ophthalmologist	R2 (pre-proliferative retinopathy), venous beading, venous reduplication, intraretinal microvascular abnormality, multiple blot haemorrhages	Moderate non-proliferative retinopathy	43	11.3%
		Moderately severe non-proliferative retinopathy	47	20.7%
		Severe non-proliferative retinopathy	53	44.2–54.8%
Urgent referral to ophthalmologist	R3 (proliferative)	Proliferative diabetic retinopathy	61 and greater	Proliferative diabetic retinopathy has developed
<b>English maculopathy classification (M levels—M0 or M1)*</b>				
Re-screen in 12 months	M0	None of the features below		
Routine referral to ophthalmologist	M1	Exudate within 1 disc diameter of the centre of the fovea		
Routine referral to ophthalmologist	M1	Circinate or group of exudates within the macula		
Routine referral to ophthalmologist	M1	Any microaneurysm or haemorrhage within 1 disc diameter of the centre of the fovea only if associated with a best visual acuity of $\leq 6/12$ (if no stereo)		
Routine referral to ophthalmologist	M1	Retinal thickening within 1 disc diameter of the centre of the fovea (if stereo available)		

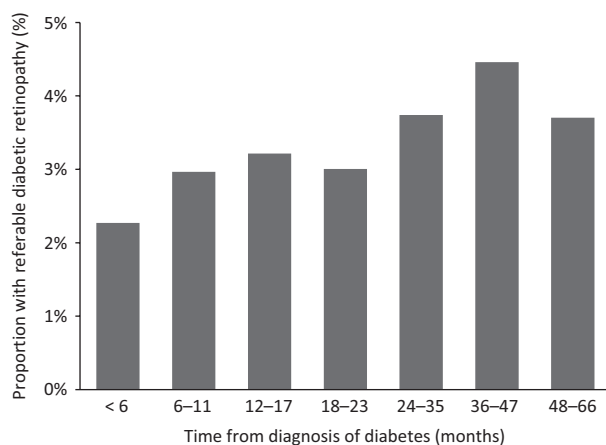
\*Retinopathy R level must be at least R1 to classify any M1. ETDRS, Early Treatment Diabetic Retinopathy Study;

(M) grade on the basis of the absence, presence and severity of features of diabetic retinopathy found during grading of the retinal images. The criteria used for grading and allocation of retinopathy and maculopathy levels in the Gloucestershire Diabetic Eye Screening Programme, which are those required by the English NHS Diabetic Eye Screening Programme [7], and the relationship to the Early Treatment Diabetic Retinopathy Study (ETDRS) severity scale [8,9] are shown in Table 1.

Any diabetic retinopathy was defined as having a grade other than R0M0 in at least one eye. Referable diabetic retinopathy was defined by the presence of any moderate to severe non-proliferative diabetic retinopathy (R2), proliferative diabetic retinopathy (R3) or maculopathy (M1) in either eye. Patients with unassessable images were excluded from the analyses here.

## Results

Data were available for 8183 patients newly diagnosed with diabetes between 2005 and 2007.



**FIGURE 1** Proportion of subjects with referable diabetic retinopathy;  $\chi^2$  for trend,  $P = 0.0004$ .

**Table 2** Relationship between time from diagnosis to screening and diabetic retinopathy severity

Time from diagnosis of diabetes to screening	No retinopathy (R0M0) in both eyes	Background retinopathy (R1M0) in one eye	Background retinopathy (R1M0) in both eyes	Referable diabetic retinopathy
< 6 months	2449 68.6%	719 20.1%	320 9.0%	81 2.3%
6-11 months	1610 68.2%	463 19.6%	218 9.2%	70 3.0%
12-17 months	689 65.1%	231 21.8%	104 9.8%	34 3.2%
18-23 months	239 65.3%	80 21.9%	36 9.8%	11 3.0%
24-35 months	273 63.8%	93 21.7%	46 10.7%	16 3.7%
36-47 months	109 69.4%	28 17.8%	13 8.3%	7 4.5%
48-66 months	47 58.0%	15 18.5%	16 19.8%	3 3.7%

$\chi^2$ -test for trend,  $P = 0.0004$ .

Only 163 with Type 1 diabetes were available, which was an insufficient number to show any trends in the analysis, and hence these subjects were excluded.

Data were available for 8020 subjects with newly diagnosed Type 2 diabetes (see Fig. 1 and Table 2).

Of these, 3569 were screened within 6 months, 2361 were screened between 6 and 11 months, 1058 between 12 and 17 months, 366 between 18 and 23 months, 428 between 24 and 35 months and 238 at 3 years or more after diagnosis.

Overall, there were 5416 (67.5%) graded with no retinopathy (R0M0) in both eyes, 1629 (20.3%) with background non-referable retinopathy (R1M0) in one eye, 753 (9.4%) with background diabetic retinopathy (R1M0) in both eyes and 222 (2.8%) with referable diabetic retinopathy in one or both eyes.

There was a significant trend ( $P = 0.0004$ ) relating time from diagnosis to screening, with worsening diabetic retinopathy.

Of those screened within 6 months of diagnosis, 2.3% had referable diabetic retinopathy. In those screened 3 years or more after diagnosis, 4.2% had referable diabetic retinopathy.

## Discussion

Zoega *et al.* [10] described the relationship between non-attendance for diabetic retinopathy screening and blind registration in a small population of 22 people with diabetes registered blind in Iceland.

We recently published [11] an audit that we undertook in a large general practice in Gloucester, which demonstrated that attendance for diabetic eye screening was inversely associated with HbA<sub>1c</sub> ( $P < 0.0001$ ), systolic and diastolic blood pressure ( $P = 0.005$ ), suggesting that those with the poorest control of their diabetes and blood pressure were least likely to attend.

Other factors that are known to affect attendance are:

1. Patient age—younger patients had a higher propensity for non-attendance at diabetic retinopathy screening [12,13].
2. Socio-economic deprivation [14].

3. Type of diabetes—attendance rates at diabetic retinopathy screening were found to be lower in patients with Type 1 diabetes [13].

This current study has demonstrated that the rate of detection of referable diabetic retinopathy is higher in those who were not screened promptly after diagnosis of Type 2 diabetes. This study does not differentiate between whether those who were screened later had more severe diabetic retinopathy at diagnosis or whether the lateness in being screened was related to the compliance issues that have previously been published. It also does not differentiate between people with diabetes who have good or poor control of blood glucose, because English NHS Diabetic Eye Screening Programmes do not routinely have access to HbA<sub>1c</sub> data. It does, however, indicate that it would be beneficial to screen people within the current National Institute for Health and Clinical Excellence (NICE) [15] Quality Standard of within 3 months of diagnosis.

It also suggests that a new Quality Standard should be introduced in the English NHS Diabetic Eye Screening Programme to minimize the number of people who have a long delay in their first screening appointment and, in particular, the number of people who have not taken up their offer of screening within 3 years of diagnosis.

#### Funding sources

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#### Competing interests

None declared.

#### References

- 1 Klein R, Klein BE, Moss SE, Cruickshanks KJ. The Wisconsin Epidemiologic Study of diabetic retinopathy. XIV. Ten-year incidence and progression of diabetic retinopathy. *Arch Ophthalmol* 1994; **112**: 1217–1228.
- 2 Kohner EM, Aldington SJ, Stratton IM, Manley SE, Holman RR, Matthews DR *et al.* UK Prospective Diabetes Study, 30: diabetic retinopathy at diagnosis of non-insulin-dependent diabetes mellitus and associated risk factors. *Arch Ophthalmol* 1998; **116**: 297–303.
- 3 Marmot M, Brunner E. Cohort profile: the Whitehall II study. *Int J Epidemiol* 2005; **34**: 251–256.
- 4 Bek T, Lund-Andersen H, Hansen AB, Johnsen KB, Sandbaek A, Lauritzen T. The prevalence of diabetic retinopathy in patients with screen-detected type 2 diabetes in Denmark: the ADDITION study. *Acta Ophthalmol* 2009; **87**: 270–274.
- 5 Porta M, Curletto G, Coppo E, Raviolo A, Sitia E, Albani S *et al.* Estimating the interval preceding diagnosis of Type 2 diabetes from the time course of retinopathy prevalence (EASDec conference abstract). *Eur J Ophthalmol* 2013; **23**: 453.
- 6 Harris MI, Klein R, Welborn TA, Knudman MW. Onset of NIDDM occurs at least 4–7 years before clinical diagnosis. *Diabetes Care* 1992; **15**: 815–819.
- 7 Harding S, Greenwood R, Aldington S, Gibson J, Owens D, Taylor R *et al.* Grading and disease management in national screening for diabetic retinopathy in England and Wales. *Diabet Med* 2003; **20**: 965–971.
- 8 Early Treatment Diabetic Retinopathy Study (ETDRS) Research Group. Grading diabetic retinopathy from stereoscopic color fundus photographs—an extension of the modified Airlie House classification. ETDRS report number 10. *Ophthalmology* 1991; **98**: 786–806.
- 9 Early Treatment Diabetic Retinopathy Study (ETDRS) Research Group. Fundus photographic risk factors for progression of diabetic retinopathy. ETDRS report number 12. *Ophthalmology* 1991; **98**: 823–833.
- 10 Zoega GM, Gunnarsdottir T, Bjornsdottir S, Hreiðarsson AB, Viggosson G, Stefansson E. Screening compliance and visual outcome in diabetes. *Acta Ophthalmol Scand* 2005; **83**: 687–690.
- 11 Sachdeva A, Stratton IM, Unwin J, Moreton R, Scanlon PH. Diabetic retinopathy screening: study to determine risk factors for non-attendance. *Diabetes Prim Care* 2012; **14**: 308–316.
- 12 Leese GP, Boyle P, Feng Z, Emslie-Smith A, Ellis JD. Screening uptake in a well-established diabetic retinopathy screening program: the role of geographical access and deprivation. *Diabetes Care* 2008; **31**: 2131–2135.
- 13 Millett C, Dodhia H. Diabetes retinopathy screening: audit of equity in participation and selected outcomes in South East London. *J Med Screen* 2006; **13**: 152–155.
- 14 Scanlon PH, Carter SC, Foy C, Husband RF, Abbas J, Bachmann MO. Diabetic retinopathy and socioeconomic deprivation in Gloucestershire. *J Med Screen* 2008; **15**: 118–121.
- 15 NICE. *Screening and Early Management of Diabetic Retinopathy in Type 2 Diabetes*. London: National Institute for Health and Clinical Excellence, 2002.