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ARTICLE

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Long-term follow-up and outcomes of a Diabetic Eye Screening Programme in patients aged 80 with no diabetic eye disease at baseline: should we be routinely screening this cohort?

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BACKGROUND/OBJECTIVES: It remains unclear whether routine annual diabetic eye screening is still warranted for individuals aged 80 and over who show no signs of retinopathy at baseline. This study aimed to determine the incidence of referable diabetic retinopathy (DR) or diabetic maculopathy in individuals aged 80 years and older with no retinopathy at baseline in the South East London NHS Diabetic Eye Screening Programme (DESP), and to estimate the proportion requiring treatment.

SUBJECT/METHODS: Data from the South East London DESP were linked with Hospital Eye Service (HES) records from 2009 to 2025. Individuals aged 80 years during 2009–2014 with no diabetic retinopathy or maculopathy (R0M0) at baseline and at least five years of follow-up were included. Screening and hospital data were analysed to determine referrals, diagnoses and treatments.

RESULTS: Of 3599 eligible participants, 3258 (90.5%) had no referable diabetic retinopathy or diabetic maculopathy at final screening. In total, 532 (14.8%) were referred to HES, mainly for non-diabetic causes (56.6%). Referrals for sight-threatening diabetic retinopathy accounted for 89 cases (2.5%), and only four individuals (0.11%) required treatment, all for diabetic macular oedema. No cases of proliferative diabetic retinopathy were identified.

CONCLUSIONS: Among people aged 80 years and older without diabetic retinopathy at baseline, the incidence of sight-threatening disease and treatment need were extremely low. Routine DESP recall in this population may offer limited clinical benefit and should be reconsidered within a risk-stratified screening framework.

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INTRODUCTION

According to Diabetes UK registration figures for 2023–24, more than 5.8 million people are estimated to be living with diabetes in the United Kingdom, which represents the highest prevalence recorded to date; among them, ~1.5 million are aged over 65 years [1]. This number is expected to continue rising, particularly among older adults, who are at increased risk of multiple comorbidities, thereby presenting a growing public health challenge [2].

In England, the National Health Service (NHS) Diabetic Eye Screening Programme (DESP) has provided regular screening to all individuals with diabetes aged 12 years and older since 2003. Unlike other national screening programmes [3], the DESP has no upper age limit. As the prevalence of diabetes continues to climb, diabetic eye screening services are under increasing pressure, raising concerns about the long-term financial sustainability of the programme [4]. Age restrictions in screening programmes are often introduced because, in older populations, the likelihood of death from competing causes may outweigh the potential clinical benefits of detection and treatment.

Diabetic retinopathy (DR) affects approximately one third of adults with diabetes and, largely due to the screening programme, has been reported to no longer be the commonest cause of sight loss in working-age adults [5]. Although still an important cause of visual impairment, evidence suggests that DR is not strongly associated with advanced age [6, 7]: despite the high prevalence of diabetes among older adults, the incidence of DR in this demographic is relatively low [8, 9], and progression to proliferative stages is uncommon [10].

The present study aimed to determine the incidence of referable DR or diabetic maculopathy in individuals aged 80 years or older, with at least five years of follow-up among those without retinopathy at baseline, and to estimate the proportion subsequently requiring treatment. The ultimate objective was to evaluate whether this cohort may be considered a low-risk category for sight-threatening disease.

MATERIALS AND METHODS

This retrospective cohort study analysed data from all patients attending the Diabetic Eye Screening Programme in South East London, following

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Table 1. Comparison of the English Diabetic Eye Screening Programme (DESP) grading system and International Clinical Diabetic Retinopathy (ICDR) severity scale.

DESP grading system	ICDR severity scale
R0 - No diabetic retinopathy	No diabetic retinopathy (DR)
R1 - Background retinopathy (presence of at least one microaneurysm)	Mild non-proliferative diabetic retinopathy (NPDR)
R2 - Pre-proliferative retinopathy with the presence of: • Any venous beading or • Multiple deep, round or blot haemorrhages in 4 quadrants or • Any IRMA formation visible on the colour fundus image.	Moderate - Severe NPDR
R3a – Proliferative retinopathy with the presence of: • Any new vessels on disc (NVD) or • Any new vessels elsewhere (NVE) or • Are-retinal or vitreous haemorrhage or • Are-retinal brosis ± tractional retinal detachment	Proliferative DR
R3s - Stable treated proliferative retinopathy with the presence of PRP laser scars	
M0 - Non-referable maculopathy • No maculopathy or any microaneurysm or haemorrhage within 1DD of centre of the fovea if associated with VA better than 6/12	No macular oedema
M1 - Referable maculopathy, which includes any of the following: • Any exudate within 1 disc diameter (DD) of the centre of the fovea • Any circinate or group of exudates within the macula > ½ disc area • Any retinal thickening within 1DD of the centre of the fovea (if stereo available) • Any microaneurysm or haemorrhage within 1DD of the centre of the fovea, only if associated with a best VA of worse than or equal to 6/12 (if no stereo)	Macular Oedema

DD disc diameter, *DESP* Diabetic Eye Screening Programme, *ICDR* International Clinical Diabetic Retinopathy, *IRMA* Intraretinal Microvascular Abnormalities, *NVD* neovascularization of the disc, *NVE* neovascularization elsewhere, *VA* visual acuity.

local audit approval No. 17032. A confirmed diagnosis of diabetes, made by the general practitioner or hospital physician, is a mandatory prerequisite for enrolment in the NHS DESP; verification of the underlying diagnosis was therefore outside the scope of this database study. Participants were identified from the OptoMize Screening Database, and eligibility criteria included age of 80 years during the baseline period (2009–2014), absence of diabetic retinopathy or maculopathy at baseline (R0M0), and a minimum follow-up of five years. Patients who died during the observation period were retained in the analysis regardless of the number of completed screening encounters, to avoid survival bias and to ensure that the estimates of retinopathy incidence reflect the natural history of the condition in this age group, including in individuals with the shortest survival.

DR grading was derived from colour fundus photographs acquired through the UK DESP protocol, which consists of two-field (disc- and macula-centred) 45° images obtained after mydriasis. Images were assessed by human graders for evidence of retinopathy or maculopathy. DR grades were defined using the criteria of the UK National Screening Committee [11]. A correspondence table mapping English DESP grades to their approximate International Clinical Diabetic Retinopathy (ICDR) severity scale [12] equivalents is provided in Table 1. Referable maculopathy was defined according to UK DESP criteria as any of the following: the presence of any exudate within one disc diameter of the fovea; a group of exudates within the macula (defined as an area of exudates greater than or equal to half the disc area located within the macular area); retinal thickening within one disc diameter of the centre of the fovea, or a visual acuity of 6/12 or worse in the presence of any haemorrhage or microaneurysm within one disc diameter of the fovea. Extracted data included age, ethnicity, diabetes type and duration, DR grading in the worse-seeing eye up to the last available screening, referral to a Hospital Eye Service (HES), reason for referral, and subsequent management. DESP and hospital treatment records were electronically linked using NHS numbers. Outcomes following referral to HES were obtained from hospital records spanning from 2009 to 2025.

Descriptive statistics were applied to summarise baseline characteristics. Normally distributed variables are presented as mean ± standard deviation, whereas non-normally distributed variables are reported as median with interquartile range (IQR). Statistical analysis was performed using Stata version 17.0 software (StataCorp LP, College Station, TX, USA).

RESULTS

At the time of the database search in July 2025, there were 5528 patients aged 80 years during the baseline period (2009–2014), 5430 of whom had a follow-up of at least 5 years; the 98 patients excluded solely on the basis of insufficient follow-up represented 1.77% of the eligible population. Of the 5430 patients meeting the follow-up criterion, 3599 patients had no signs of DR or maculopathy (DR grading R0M0) at their baseline screening encounter and were therefore included in this cohort. Of these, 738 (20.51%) died during the observation period with fewer than five annual screening encounters and were nevertheless retained in the analysis to avoid survival bias. Demographic characteristics of the cohort, extracted from the most recent documented encounter within DESP or HES, are summarised in Table 2. A summary of the demographic, screening grades and outcomes recorded in the last available DESP encounter is shown in Table 3.

At the last available screening encounter, most patients (2615, 72.66%) showed no evidence of diabetic maculopathy or retinopathy (R0M0) or had background retinopathy (or mild non-proliferative retinopathy) without maculopathy (R1M0; 643, 17.87%). Therefore, more than 90% (90.53%) of this cohort had no referable retinopathy or maculopathy at their last screening encounter. Additionally, 41 patients (1.14%) were excluded from screening at their latest encounter owing to being medically unfit (40, 1.11%), and one patient was excluded because of bilateral no perception of light secondary to end-stage glaucoma. Of the 3599 patients included, 532 were referred to the HES at least once during follow-up. Referral reasons were unassessable images (142, 26.69%), referable diabetic retinopathy or maculopathy (89, 16.73%), and non-diabetic retinopathy causes (301, 56.58%). Among those referred to HES, 26 did not attend their appointment, and 17 patients died soon after referral, before being seen in hospital. Over the entire follow-up period, spanning from the inclusion of participants in the over-80 cohort to the database analysis conducted in July 2025, a total of 2681 individuals (74.49% of the cohort) had deceased.

Table 2. Demographic characteristics from the latest DESP or HES encounter.

Total	***n* = 3599**
Female gender, *n* (%)	1787 (49.65)
Mean duration of diabetes, years (SD)	17.47 (±7.34)
Mean duration of follow-up in over-80s cohort, years (SD)	8.51 (±3.64)
Diabetes type, *n* (%)	
Type 1	24(0.67)
Type 2	3560 (98.92)
Other	1 (0.03)
Unknown	14 (0.39)
Ethnicity, *n* (%)	
Afro-Caribbean	509 (14.14)
Any other Asian background	82 (2.28)
Any other ethnic group	33 (0.92)
Any other mixed background	38 (1.06)
Bangladeshi/Indian/ Pakistani	116 (3.22)
Caucasian/Any other white background	2320 (64.46)
Unknown	501 (13.92)

DESP Diabetic Eye Screening Programme, *HES* Hospital Eye Service, *SD* standard deviation.

Table 3. Demographic and clinical characteristics of the cohort at last available screening encounter at DESP.

		***n* = 3599**
Patients deceased during follow-up, *n* (%)		2681 (74.49)
Age of death, mean (SD)		87.98 (±3.36)
Age at last available follow-up, *n* (%)	Age range (years)	
	80 - 84	1199 (33.31)
	85–89	1409 (39.15)
	≥ 90	991 (27.54)
DR grade at last available encounter		
	R0M0	2615 (72.66)
	R1M0	643 (17.87)
	R1M1	86 (2.36)
	R2M0	6 (0.17)
	R2M1	5 (0.14)
	R3AM0	1 (0.03)
	R3AM1	2 (0.06)
	R3SM0	0 (0)
	R3SM1	0 (0)
	Unassessable	242 (6.72)
Outcome of last available screening encounter		
	Kept in DESP	3202 (88.97)
	Excluded from DESP	41 (1.14)
	Referred to HES as unassessable	74 (2.06)
	Referred to HES for DR	65 (1.81)
	Referred to HES for non-DR	217 (6.03)

DESP Diabetic Eye Screening Programme, *DR* diabetic retinopathy, *HES* Hospital Eye Service, *SD* standard deviation.

Sight-threatening diabetic retinopathy (STDR) accounted for a smaller proportion of referrals (2.47% of the total patient cohort, 16.73% of all referrals to HES), with the following distribution: R1M1 (mild non-proliferative retinopathy with maculopathy: 76 cases, 2.11%), R2M0 (equivalent to moderate-to-severe non-proliferative diabetic retinopathy (NPDR) without maculopathy: 4 cases, 0.11%), R2M1 (moderate-to-severe NPDR with maculopathy: 4 cases, 0.11%), R3AM0 (proliferative DR without maculopathy: 3 cases, 0.08%), and R3AM1 (proliferative DR with maculopathy: 2 cases, 0.06%). In total, eight patients were referred as moderate-to-severe NPDR (R2: 4 cases of R2M0 and 4 cases of R2M1), and five patients were referred with suspected proliferative diabetic retinopathy (PDR; 3 cases of R3AM0 and 2 cases of R3AM1). Of these, two were referred as R3AM0 (active proliferative diabetic retinopathy) during follow-up: one was subsequently reclassified as R0M0 with active neovascular age-related macular degeneration (AMD) and received appropriate treatment; after seven years of follow-up, the DR grade remained R0M0. The second was downgraded to R0M0 due to a non-diabetic vitreous haemorrhage resulting from neovascular glaucoma secondary to a central retinal vein occlusion. A third patient, recorded as R3AM0 at the final screening visit, was reclassified as R0M0 owing to neovascularisation secondary to a retinal vein occlusion and treated with panretinal photocoagulation. The remaining two patients were referred as R3AM1 at their last screening visit; one was reclassified as R1M1 (mild non-proliferative diabetic retinopathy with maculopathy) and monitored in hospital without requiring treatment, while the other was reclassified as R2M0 (moderate to severe non-proliferative retinopathy) with cystoid macular oedema secondary to central retinal vein occlusion.

Among the patients referred for DR, the outcomes in HES indicated that only four individuals (0.11%) ultimately received treatment for diabetic eye disease. All four were treated for diabetic macular oedema: two with intravitreal anti-VEGF therapy and two with focal laser. No patient was diagnosed with PDR and therefore none required panretinal photocoagulation.

Of the DR referrals, 22 patients were discharged back to DESP, while 43 remained under HES monitoring without treatment. Ten DR referrals were redirected to treatment for other ocular conditions, including post-operative cystoid macular oedema (CMO), epiretinal membrane, AMD, CMO secondary to retinal vein occlusion, and cataract. Four did not attend their HES appointment, and five died shortly after being referred. Hospital records could not be obtained for one patient, who had been referred as R1M1(mild non-proliferative retinopathy with maculopathy); DESP software indicates that this patient remained under follow-up in HES and was not discharged back to DESP, though no treatment was documented.

A considerably larger proportion of referrals were for non-DR-related reasons (301, 56.58%), as detailed in Fig. 1. The most frequent included AMD, cataract, glaucoma, central or branch retinal vein occlusion, posterior capsular opacification, and other conditions such as non-DR-related visual loss, choroidal naevus,

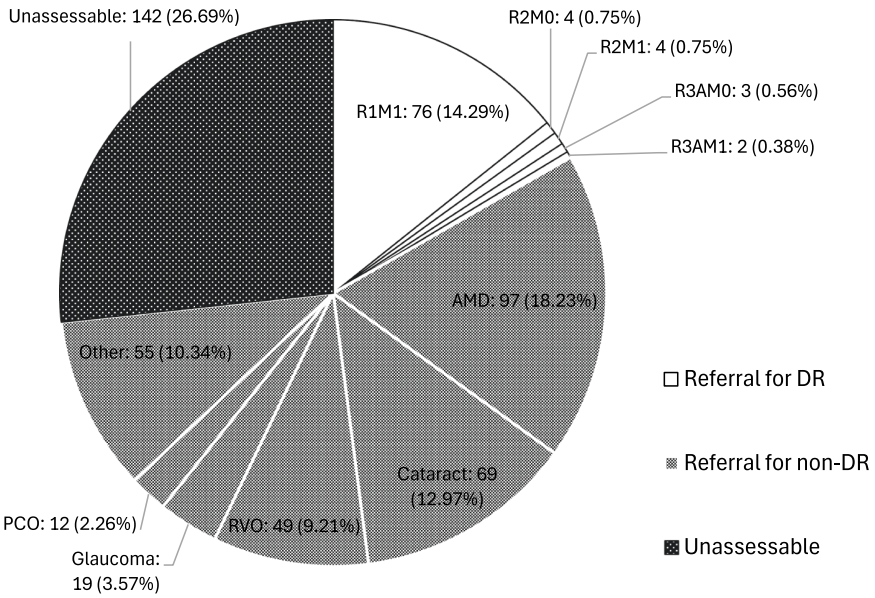

Fig. 1 Reasons for referral to Hospital Eye Service. AMD age-related macular degeneration, DR diabetic retinopathy, RVO retinal vein occlusion, PCO posterior capsular opacification.

emboli, asteroid hyalosis, macular hole, central serous chorioretinopathy, and myopic macular neovascularisation.

Notably, no patient referred as unassessable was later found to have STDR. A synthesis of the outcomes of HES referrals is represented in Fig. 2.

DISCUSSION

The number of individuals aged over 80 attending diabetic eye screening is steadily rising. However, an increasing body of evidence indicates that the development of STDR in older individuals is uncommon. As early as the 1990s, the Oulu Study [13] demonstrated that, despite the high prevalence of diabetes mellitus in the elderly population, the prevalence of vision-threatening diabetic retinopathy remained low, with progression from background to proliferative retinopathy being particularly uncommon in older patients. Morisaki et al. [14], in a five-year follow-up study of individuals over 60 years of age, identified only a single case of PDR among patients without retinopathy at baseline. Similarly, in their review, Klein et al. [15] reported no cases of PDR in patients aged 80 years or older. More recent evidence confirms this pattern. Tye et al. [16], examining a UK cohort of patients aged over 90, observed a referral rate to the HES for DR of 1%, with only 0.5% requiring laser treatment. Thomas et al. [17] examined cohorts of patients aged 80 and 85 years from the Birmingham, Solihull and Black Country DESP with four years of follow-up; they found referral rates to HES for DR of 4% in the 80-year cohort and 2.4% in the 85-year cohort, with even fewer requiring treatment (0.6% and 0.4%, respectively); notably, all treated cases were due to diabetic maculopathy, and no cases of PDR were reported. Brodie et al. [18], analysing data from the Norfolk DESP, similarly found that among participants aged over 70 years, only 0.6% required laser treatment and 0.8% required intravitreal injections.

Our findings are consistent with these observations. It is worth noting, however, that this cohort excludes higher-risk individuals already referred to the HES before the age of 80 with referable retinopathy, who fall outside the screening programme and should continue to be reviewed in the Hospital Eye Clinic. In our cohort of 3599 screened patients, the referral rate for STDR was 2.47%, with only 0.11% (4 patients) ultimately requiring treatment. Both referral and treatment rates were slightly lower than those reported in previous studies, likely because our analysis included only individuals without diabetic retinopathy or maculopathy at baseline, whereas other studies encompassed all participants regardless of their initial retinopathy status. All participants who required treatment had diabetic maculopathy rather than referrable retinopathy, and such cases typically become symptomatic before intravitreal therapy is indicated, suggesting they could still be detected, albeit slightly later, even in the absence of regular screening. Given that only four patients ultimately required treatment for diabetic maculopathy, the sample was too small to allow meaningful analysis of potential risk factors such as age, ethnicity, diabetes type or duration, and no statistically reliable conclusions could be drawn regarding predictors of treatment need in this cohort. Notably, no patient referred for maculopathy declined the treatment when offered. It should be acknowledged that a portion of the dataset predates the introduction of Optical Coherence Tomography (OCT) into DESP, when the referral threshold for diabetic maculopathy was lower than it is today. With data collected after the implementation of OCT within the DESP, it is likely that the referral rate to HES for diabetic maculopathy would be even lower.

The limited benefit of screening in this age group is further compounded by comorbidities, which often restrict attendance and limit the feasibility of treatment. In our cohort, 738 patients (20.51%) had a follow-up shorter than five years due to death during the observation period. Moreover, mortality shortly after referral reduces the likelihood that screening can meaningfully influence visual outcomes in this population. Stratification by age subgroup at the last available follow-up encounter, as shown in Table 3, revealed that 1409 (39.15%) were aged 85-89 years, and over one quarter of the cohort (27.54%) reached the age of 90 years or above, reflecting the extended duration of follow-up and underscoring the advanced age of this population, in whom competing causes of mortality are particularly relevant when evaluating the clinical benefit of continued screening. These results raise important considerations in balancing clinical benefit with the optimal use of healthcare resources across different patient groups.

In line with previous evidence [13, 16, 17], our findings also emphasise the broader role of DESP in identifying ocular conditions other than DR that warrant referral to secondary care, with the majority of referrals in our cohort attributable to non-DR pathology. Although this opportunistic detection represents an

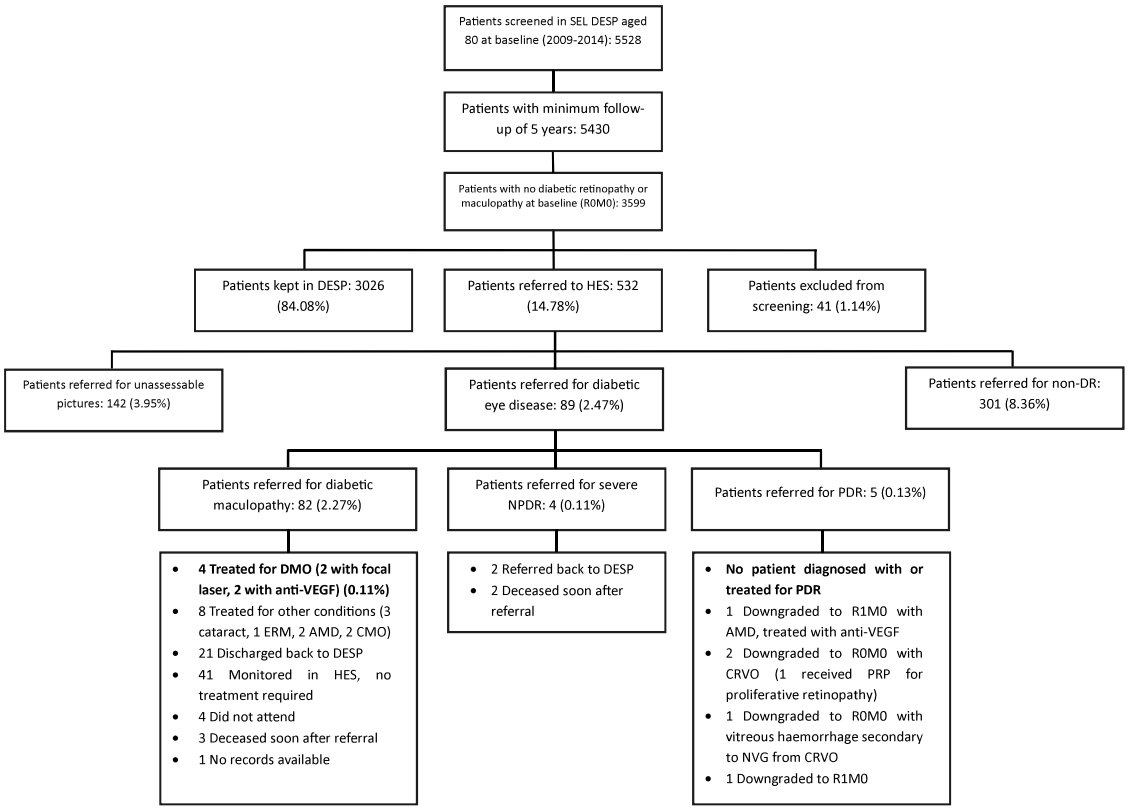

Fig. 2 Outcomes of diabetic retinopathy screening and hospital eye service referrals. AMD age-related macular degeneration, anti-VEGF anti-vascular endothelial growth factor, CMO cystoid macular oedema, DESP Diabetic Eye Screening Programme, DMO diabetic macular oedema, DR diabetic retinopathy, ERM epiretinal membrane, HES Hospital Eye Service, NPDR non-proliferative diabetic retinopathy, NVG neovascular glaucoma, PDR proliferative diabetic retinopathy, SEL DESP South East London Diabetic Eye Screening Programme.

additional benefit, it is not the primary aim of the Diabetic Eye Screening Programme. Rather, it highlights the need to develop more comprehensive pathways for routine eye examinations led by optometrists, focusing on the early recognition of non-diabetic ocular disease across the general population. Currently, this valuable case-finding activity remains confined to people with diabetes, as systematic eye assessment is not widely accessible beyond this group. A more efficient allocation of resources could enable expansion of such preventive care through enhanced community and domiciliary optometric services, thereby promoting equitable access to eye health and supporting earlier detection and management of sight-threatening conditions at the population level rather than just restricted to those with diabetes eligible for screening. Formal reminder systems, such as structured recall letters, could provide a more reliable mechanism to promote attendance, reducing dependence on patient-initiated consultations.

A key strength of our study is that it is based on a large, diverse population dataset, with extended follow-up and linkage of DESP data to hospital medical records. This approach enabled the evaluation of outcomes in terms of treatment and demonstrated that only a very small proportion of patients (0.11%) in this cohort ultimately received therapy for diabetic eye disease.

A limitation of the study is the assumption that participants did not receive treatment unless recorded in the St Thomas' Hospital or King's College Hospital datasets. This assumption is plausible, as these are the only centres providing laser therapy and intravitreal injections under the NHS in South East London. However, it remains possible, though unlikely, that some patients may have been treated outside this region or in private hospitals.

Another potential limitation of this study is the restriction to patients with a minimum follow-up of five years, which could theoretically favour the inclusion of healthier individuals; however, the number of patients excluded solely on this basis was very limited (98 of 5528, 1.77%), and the deliberate retention of patients who died during follow-up (738 of 3599, 20.51%) mitigates the risk of survival bias and supports the validity of the reported incidence estimates.

Furthermore, OCT was introduced into the NHS DESP after the beginning of the study period; subclinical cases of DMO may have been missed, and the true incidence of DMO may be underestimated. However, this limitation affects the sensitivity of detection rather than the principal conclusion of the study, namely that the rate of sight-threatening DR requiring treatment in individuals aged 80 and over without retinopathy at baseline is very low. The progressive integration of OCT into the screening programme is likely to further refine maculopathy detection in future studies. Additionally, the database does not routinely incorporate systemic clinical parameters such as glycated haemoglobin, or information on other diabetic complications. Future studies integrating DESP data with primary care records would allow more precise risk stratification based on systemic diabetic status. Nonetheless, the very low rate of sight-threatening DR requiring treatment (0.11%) represents a clinically meaningful and actionable finding that supports reconsideration of screening protocols in elderly patients without retinopathy at baseline, independent of systemic variables.

Given the recent introduction of two-yearly screening within the England DESP in those with no retinopathy or maculopathy [19] and the separation of the R2 cohort into low (moderate non-proliferative) and high (severe non-proliferative) risk groups to create more capacity and enhance cost-effectiveness [20], there is a clear rationale to reconsider DESP guidance for individuals aged 80 years and above. In this population, the very low detection rate of STDR makes

routine screening difficult to justify, particularly in the context of competing health risks, comorbidities, often increased costs of transport and limited life expectancy. As the NHS moves towards a risk-stratified model [18], the low risk of sight loss from diabetic retinopathy in the older population should be incorporated as a key determinant, ensuring resources are directed where screening is most likely to deliver meaningful benefit. Revising guidance to cease routine recall for individuals aged 80 and above with no evidence of retinopathy or maculopathy, or to offer them an opt-in screening option, could help preserve resources, increase programme capacity, and prioritise those at higher risk. This would also enable the development of alternative care pathways to detect other causes of sight loss in older individuals outside the screening programme, benefiting the wider population and not only those with diabetes.

SUMMARY

What was known before

- The NHS Diabetic Eye Screening Programme provides lifelong screening without an upper age limit, unlike all other Screening Programmes in the UK.
- Sight-threatening diabetic retinopathy is uncommon in older adults compared with working-age populations.
- The long-term benefit of screening individuals aged 80 years and above has not been well established.

What this study adds

- In patients aged 80 years or older with no retinopathy or maculopathy at baseline, over 97.5% remained free of referable disease after ≥5 years.
- Among a total cohort of 3599 participants, only 0.11% required treatment for diabetic eye disease, with no cases of proliferative retinopathy observed.
- Routine screening in elderly, low-risk individuals may provide limited clinical benefit and could be reconsidered within a risk-stratified model.

DATA AVAILABILITY

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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AUTHOR CONTRIBUTIONS

SM led study conceptualisation. LW led the data acquisition. AP prepared the original manuscript draft. All authors (AP, LW, HE, SM) contributed to data acquisition. LW led the data analysis. All authors (AP, LW, HE, SM) contributed to data interpretation, and manuscript revision.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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