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Patient and practitioner perceptions around use of artificial intelligence within the English NHS diabetic eye screening programme

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ABSTRACT

Aims: Automated retinal image analysis using Artificial Intelligence (AI) can detect diabetic retinopathy as accurately as human graders, but it is not yet licensed in the NHS Diabetic Eye Screening Programme (DESP) in England. This study aims to assess perceptions of People Living with Diabetes (PLD) and Healthcare Practitioners (HCP) towards AI's introduction in DESP.

Methods: Two online surveys were co-developed with PLD and HCP from a diverse DESP in North East London. Surveys were validated through interviews across three centres and distributed via DESP centres, charities, and the British Association of Retinal Screeners. A coding framework was used to analyse free-text responses.

Results: 387 (24%) PLD and 98 (37%) HCP provided comments. Themes included trust, workforce impact, the patient-practitioner relationship, AI implementation challenges, and inequalities. Both groups agreed AI in DESP was inevitable, would improve efficiency, and save costs. Concerns included job losses, data security, and AI decision safety. A common misconception was that AI would directly affect patient interactions, though it only processes retinal images.

Conclusions: Limited understanding of AI was a barrier to acceptance. Educating diverse PLD groups and HCP about AI's accuracy and reliability is crucial to building trust and facilitating its integration into screening practices.

1. Introduction

The English NHS Diabetic Eye Screening Programme (DESP) generates > 12 million retinal images annually, which require human grading for diabetic retinopathy (DR). These retinal images are assessed by up to three trained human graders for the presence and severity of DR, and those with potentially sight-threatening disease are referred to Hospital Eye Services. As the number of people living with diabetes is increasing, this represents a major challenge to healthcare providers. Emerging automated retinal image analysis systems (ARIAS) using Artificial Intelligence (AI) could provide a cost-effective alternative to a purely human grading system. Research has demonstrated that these AI systems can identify images with sight-threatening DR as well as human graders, potentially reducing workload and improving efficiency compared with manual grading of images [1–5].

Some countries are already using ARIAS to initially screen images for DR, with others looking to adopt this technology [3]. However, ARIAS are not currently approved for use in the English NHS DESP, despite a recent review recommending staged implementation of one commercially available system [3,4]. However, evaluations of test performance alone are insufficient, and medical policy around AI in healthcare should be underpinned by patient and public health outcomes [6,7].

Abbreviations: AI, Artificial Intelligence; ARIAS, Automated Retinal Image Analysis Systems; DESP, Diabetic Eye Screening Programme; DR, Diabetic Retinopathy; PLD, People Living with Diabetes; HCP, healthcare practitioners.

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For AI to be fully accepted and benefits realised, a recent report stated that 'it must command the confidence of patients, the public and NHS staff' [8]. To achieve this, we must understand attitudes and address concerns around the use of AI in healthcare. Previous research into patient and public perspectives of AI in healthcare, has identified several important themes including public acceptability and confidence of AI in healthcare, trust, regulation, and how AI could alter the patient/practitioner relationship [9–16].

These themes resonate with our own work examining perceptions among people living with diabetes (PLD) and healthcare practitioners (HCP) on the potential use of AI in the English NHS DESP. We invited PLD and HCP from the North East London DESP (a large and particularly ethnically diverse English NHS DESP) to participate in focus groups to co-design two separate surveys, to ascertain views and concerns around AI-assisted diabetic eye screening [17]. The current study is based on qualitative data provided in a free-text box as part of the survey, which provided additional ideas, concerns and thoughts about introducing AI in the diabetic eye screening pathway beyond those captured from the structured questions. We have evaluated these comments to provide an understanding of the barriers and facilitators of introducing AI into this screening pathway, which remains unclear from the wider literature.

2. Subjects, materials and methods

Full survey methodology detailing the co-design process has been published previously [17]. In summary, PLD and HCP from the North East London NHS DESP participated in two separate focus groups to co-design an online survey for their respective group. Participants' feedback in the focus groups was taken into consideration to inform survey design. Survey validation was conducted via individual interviews conducted at three DESP centres before rollout. Importantly this identified the need, by both PLD and HCP, for a free text box to collect

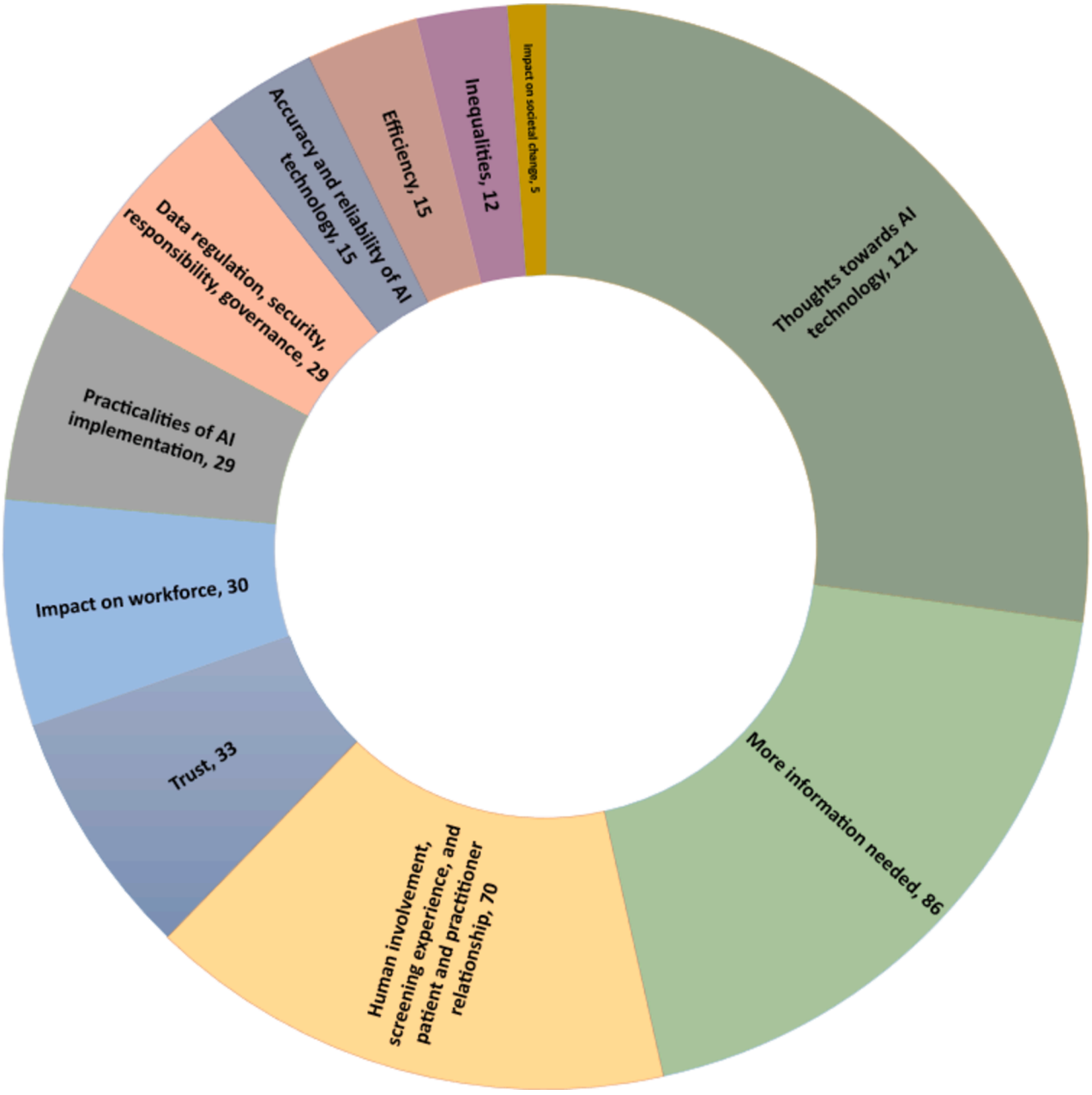

Fig. 1. Sunburst diagram showing the relative proportion of different themes identified among people living with diabetes, where sector size reflects the number of comments related to the theme.

thoughts and opinions not captured by the survey questions.

Ethical approval was obtained by the NHS Research Ethics Committee (IRAS ID: 316631). The survey opened on 1st September 2023 and closed on the 31st December 2023. The surveys for HCP and PLD comprised of 28 and 21 Likert scale questions respectively, which broadly had similar themes. The first page of the survey outlined what the research was about, why the survey was being done and what we hoped to achieve. The first page also included a statement about consent to participate in an anonymous survey, what participation in the survey would involve and a separate link to the participant information sheet. Quantitative analysis of survey results is reported elsewhere [18]. Here, we report qualitative descriptive analysis on the free-text box included in the survey asking respondents to provide any additional comments or issues they would like to raise.

An optional open-ended question asked respondents to *'Please use the box provided below to let us know about any further comments or issues you would like to raise'*. The responses in this free-text box were collated, anonymised and imported into NVivo 1.6. Descriptive analysis of the data involved an iterative process of open coding whereby three coders (CW, UC, LC) independently analysed 25 PLD comments (12 %) and 15 HCP comments (20 %). The coders then met to agree on codes and discussed discrepancies to reach a consensus. Coding took both a deductive approach, whereby comments were coded based on the initial survey domains identified when creating the survey [17], as well as an inductive approach, whereby novel codes emerged from the data. Two separate coding frameworks, one for PLD and one for HCP, were created to use when coding the subsequent comments. New codes arising from the comments were noted and incorporated into the frameworks. Final codes were reviewed and grouped into overarching themes. Verbatim comments have been displayed to illustrate themes identified. A sunburst diagram, which includes the number of comments per theme, is used to display the data for PLD and HCP (Fig. 1 and Fig. 2 respectively).

3. Results

Approximately 24 % of PLD (387/1557) and 37 % of HCP (98/262)

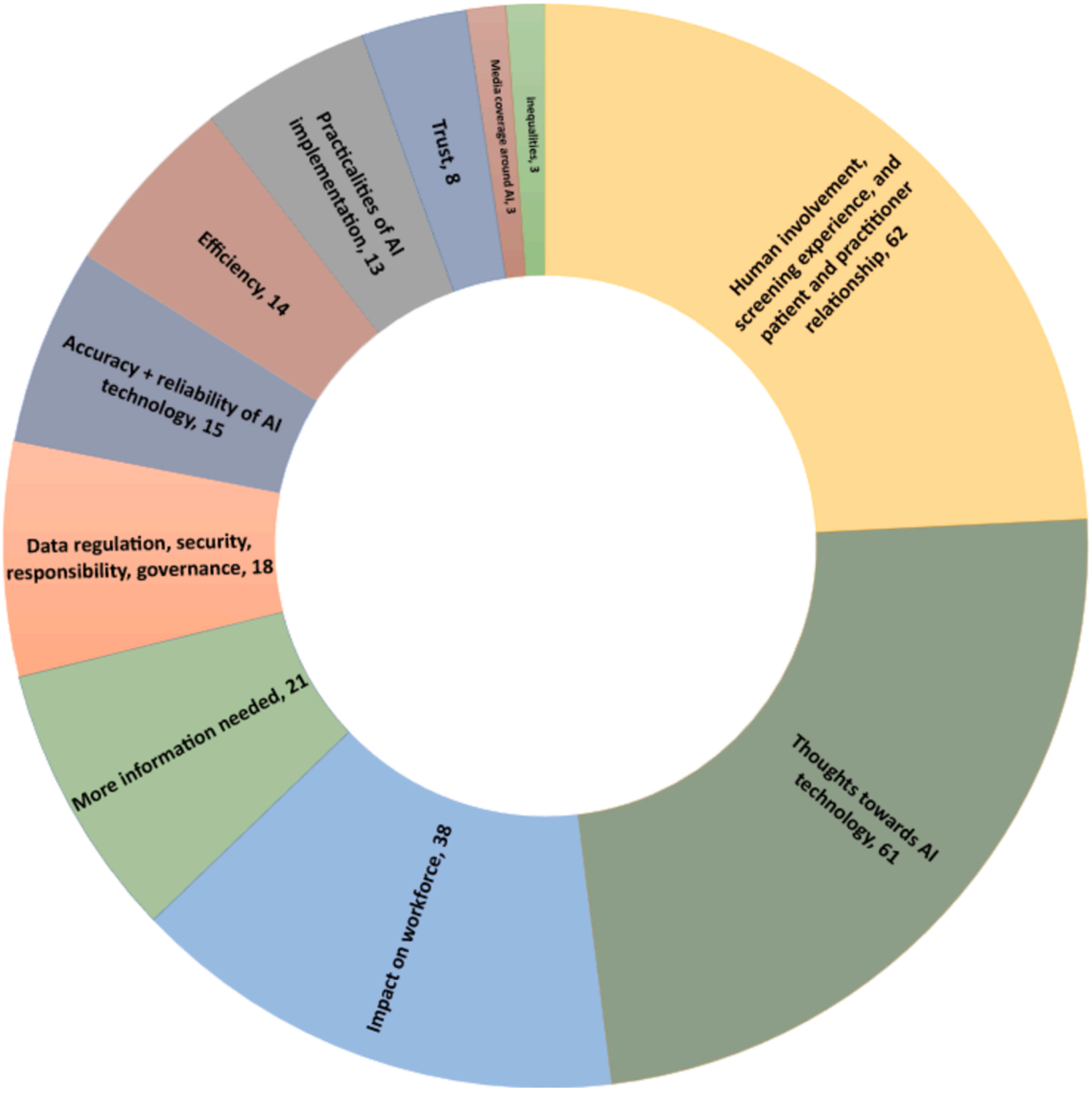

Fig. 2. Sunburst diagrams showing the relative proportion of different themes identified among healthcare practitioners, where sector size reflects the number of comments related to the theme.

respondents provided a free text comment. Demographic characteristics of all survey respondents and those that provided comments are shown in Table 1 and 2. PLD and HCP providing comments were proportionally similar by age, sex and ethnicity, to overall survey respondents (Table 1 and 2 respectively). Free text entries ranged from a single word to 285 words but were typically a sentence in length. Comments from PLD and HCP were mapped to their relevant theme (Table 3) and are represented in sunburst diagrams (Fig. 1 and 2 respectively). The identified themes were similar for both PLD and HCP so, where relevant, we have detailed common views and highlighted differences in opinions. Additional PLD and HCP quotes underpinning these views are provided in Supplemental Material*.

3.1. Themes

3.1.1. Thoughts towards AI technology

Both PLD and HCP recognised that *"AI is the future"* (Female, 64, T2, white) describing it *"as a powerful tool"* (Female, 35, administrator, white). PLD added that AI was superior to current technology and could perform better than humans at certain tasks. HCP expressed high confidence in AI technology with long-term benefits for healthcare if implemented responsibly and correctly. Some PLD spoke about AI as an objective tool, which could reduce errors and perform tasks with greater accuracy, which in turn could provide more reliable screening results and allow for earlier diagnosis. The long-term benefits of AI were recognised by HCP, who felt this technology should have been implemented earlier.

However, PLD were anxious about the use of AI, and felt there were too many "*unknowns*" (Male, 59, T2, Other). HCP additionally raised concerns over limitations in use of AI, particularly in not identifying other (non-diabetic) retinal diseases. "*My biggest concerns lie in assessment of less standard appearances, and particularly of missed non-diabetic pathology, which would be evident to a human grader.*" (Male, 41, screener/grader, white). Among PLD, a lack of understanding of how AI technology works and how performance could be future-proofed were barriers to acceptance, resulting in negative perceptions about AI. However, some HCP had a better understanding of AI, and were aware that such approaches use pattern recognition and prediction systems. Both PLD and HCP felt that AI technology should be used selectively in certain patient groups, and some PLD thought that patients should have a choice over whether AI is used. Some PLD felt that AI should be used as a back-up to human grading and that humans should have the final say.

Despite positive and negative views about the use of AI technology, both PLD and HCP acknowledged that use of AI was evolving rapidly and was inevitable, *"we should embrace new technology"* (Male, 78, T2, Asian) and some HCP spoke about it being a natural progression for such technology to be used within the DESP, *"I think that AI is the way of the future and we should all get used to it. The sooner we introduce it to healthcare, the better."* (Female, 24, screener/photographer, Black).

3.1.2. More information needed

PLD emphasised a lack of awareness about AI and questioned how AI might impact their healthcare. A key issue for PLD was the absence of patient education, with one stating, *"AI is a new technology and the level of awareness of its use is limited to patients"* (Male, 65, T2, Black). HCP similarly indicated a lack of knowledge, particularly concerning AI's role in the screening and grading processes. They expressed a need for more information, specifically *on "how AI will operate"* (Female, 50, administrator, Asian).

PLD expressed a strong need for clear and understandable explanations of AI processes, requesting *"a step-by-step guide on how it works"* (Female, 37, T2, Asian). They highlighted the necessity of simple communication to promote trust stating, *"good communications…build patient confidence."* (Male, 63, T2, White). HCP requested detailed

Table 1
Demographic details / characteristics of overall survey respondents and those that provided a free text comment for people living with diabetes (PLD).

PLD Demographics		Overall survey respondersn (%)	Provided free textn (%)	Proportion of those that completed the main survey and provided a comment, within the category specified %
Age groups (years)	< 40	66 (4.2)	12 (3.1)	18.2
	≥ 40 to < 50	145 (9.2)	34 (8.7)	23.4
	≥ 50 to < 60	326 (20.7)	69 (17.8)	21.2
	≥ 60 to < 70	545 (34.6)	127 (3.3)	23.2
	≥ 70 to ≤ 100	449 (28.5)	131 (33.9)	3.4
	Prefer not to say	46 (2.9)	14 (3.6)	30.4
Sex	Female	609 (38.6)	164 (42.4)	26.9
	Male	956 (60.6)	221 (57.1)	23.1
	Prefer not to say	12 (0.76)	2 (0.5)	16.6
Ethnicity	White	1007 (63.9)	226 (58.4)	22.4
	Asian	232 (14.7)	59 (15.2)	25.4
	Black	244 (15.5)	76 (19.6)	31.1
	Mixed/ Other/ prefer not to say	94 (6.0)	26 (6.7)	27.6
Diabetes type	Type 1 Diabetes (T1)	153 (9.7)	32 (8.3)	21.1
	Type 2 Diabetes (T2)	1294 (82.1)	319 (82.4)	24.7
	Unsure/ Other	130 (8.2)	36 (12.5)	27.7

Table 2
Demographic details / characteristics of overall survey respondents and those that provided a free text comment for healthcare practitioners (HCP).

HCP Demographics		Overall survey respondersn (%)	Provided free textn (%)	Proportion of those that completed the main survey and provided a comment, within the category specified %
Age groups (years)	18–29	34 (13.0)	12 (12.3)	35.3
	30–39	69 (26.3)	20 (20.6)	30.0
	40–49	66 (25.2)	25 (9.5)	37.8
	50–59	61 (23.3)	27 (27.8)	44.2
	60+	32 (12.2)	13 (13.4)	40.6
Sex	Female	181 (69.1)	65 (67.0)	35.9
	Male	79 (30.1)	31 (32.0)	39.2
	Prefer not to say	2 (0.8)	1 (1)	50.0
Ethnicity	White	201 (76.7)	80 (82.5)	39.8
	Asian	36 (13.7)	11 (11.3)	30.5
	Black	7 (2.7)	2 (2.1)	28.5
	Mixed/Other/ prefer not to say	18 (6.9)	4 (4.1)	22.2
Role	Clinical Lead or management position	68 (26.0)	25 (25.8)	36.7
	Senior screener / grader	59 (22.5)	19 (19.6)	32.2
	Screener, grader, photographer, or optometrist	102 (38.9)	37 (38.1)	36.2
	Administrator, fail safe officer, IT officer or other	33 (12.6)	16 (16.5)	48.4

Table 3
List of themes and associated sub-themes identified for people living with diabetes (PLD) and healthcare practitioners (HCP).

PLD	HCP
Thoughts towards AI technology	
Positive:	Positive:
• Accepting of change	• Accepting of change
• AI as an aid to improve (early) diagnosis	• AI is the future
• AI could reduce errors	• AI technology could be a great tool
• AI has greater accuracy	• Benefit of AI technology if implemented correctly
• AI is a useful tool	• High confidence in AI technology
• AI is the future	• Long-term benefits
• AI superior to current technology + humans	• AI should have been implemented earlier
• Important for prevention	
· Level of comfort using AI	
Negative:	Negative:
• Anxiety with implementation	• AI could not detect individual retinal disease
• Associated risks of using AI	• AI has limited use
• Negative feelings about using AI	• AI could be problematic in the future
• Too many unknowns	• Lack of detail on AI technology
	• Missing detection of other conditions
	• Negative opinion of AI
Other:	Other
• AI as an objective tool	• AI shouldn't be used in certain patient groups
• AI as assistance to humans	• AI systems use pattern recognition and prediction systems
• AI should be used selectively	• AI technology for disease detection
• Ensuring reliable screening results	• AI technology is a powerful tool
• Humans should have final say	• Future (development) of AI technology
• Limited use of AI within screening	• Inevitability of AI in the future
• No room for errors	• Use of AI natural progression in diabetic eye screening
• Other use of AI in healthcare	• Objectives of AI systems need to align with local DESP
• Patient choice over AI technology use	• Positives and negatives with AI technology
• Responsible use of AI technology	• Quicker evolvement of AI screening
• Utility as a back-up	• Responsible use of AI technology
More information needed	
• AI needs to be explained correctly	• Lack of knowledge in subject area
• Disseminating information on AI + AI in screening:	• Misunderstanding around AI
o Improve knowledge	• More education for patients
o Share previous + current research + findings of AI	• More research required
o Use of media	• Need for more information about the potential of AI
• Lack of awareness about what AI is	• Regular updates with research
• Processes are unclear	
• Trials required + evidence base for AI use:	
• - Information on training of AI	
Impact on workforce	
• Impact on workload of staff	• Impact on grading workload
• Job security concerns	• Impact on job recruitment
• Loss of staff knowledge + experience	• Impact on job skills – more and less skilled
• More training needed	• Impact on staff morale
• Removes mundane tasks	• Impact on staff professional identity
• Resource allocation within the NHS	• Increased referrals
	• Job security concerns
	• Positive impact on workflow
	• Staff deployment to other roles
	• Training requirements for correct use
Data regulation, security, responsibility, and governance	
• Accountability for technology	• Careful regulation
• Appropriate governance	• Data security concerns
• Concerns around system failures	• Human accountability required
• Data security concerns	• Importance of quality assurance
• Quality assurance	• Meeting required standard
	• Regular updates with technology required
	• Training of AI systems
Trust	
• Confidence from professionals	• Concerns over errors with AI
• Confidence in AI	• Greater patient reassurance about AI
• Lack of trust in accuracy of AI	• Impact on patient confidence + trust – current lack of confidence in AI
• Shouldn't be reliant on AI alone	• Need more information before trust established
o Too many unknowns	
Human involvement, screening experience, and patient and practitioner relationship	
• Communicating results	• AI as a tool working alongside humans
• Dehumanising	• AI to be used selectively within the grading process
• Need for continued human involvement in the screening process	• Alerts for human graders
o Human assessment of results	• Balance between AI and human involvement
o Human contact + interaction	• Concerns around future human involvement with AI
• Patient-practitioner relationship:	• Continued need for human involvement
o Human assistance in certain population groups	• Equivalence of humans and AI in grading
o Human contact + interaction	• Grading should be completed by humans
o Losing personal observations	• Greater reassurance with human grading
o Need more time with patients	• Human assessment of results
• Patients choice over AI technology use	• Human grading for disease level
• Post screening care	• Human involvement in decision making
• AI as a tool working alongside humans	• · Humans are superior to machines
Practicalities of AI implementation	
· Financial impact of AI – cost savings + expensive	· Determining final screening outcomes
· Gradual implementation process	· Financial impact of AI – cost savings + expensive
· Human graders to check images of interest + provide specialist input + review results	· Gradual implementation process
· More training needed	· How will AI be implemented
· Needs to be implemented properly	· · Incorrect referral pathway
· Roadmap for implementation	
· · Subject to verification	
Efficiency	
• AI more efficient	• AI technology not efficient
	• AI would increase efficiency
	• Efficiency would not increase capacity + more referrals (problematic)
	• Instant results not helpful
	• Positive impact on resources + capacity
	• Reduce backlogs
Inequalities	
• Assurances for vulnerable groups	· Biases in AI technology by ethnicity
• Barriers to attend screening	· Implications on patient attendance
• Difficulty in understanding (especially for elderly)	
• Difficulty in understanding (retired)	
• Equity of AI – benefitting everyone	
• Impact on screening attendance	
• More information on ethnic and age differences	
• Research needed on different populations	
Accuracy and reliability of AI technology	
· Concerns over accuracy in diagnosis	• AI reduces errors
	• AI technology is safe and reliable
	• Assessment of less standard images

(continued on next page)

Table 3 (*continued*)

PLD	HCP
	• Concern over accuracy • Concerns over reliability of AI in the UK • Ensuring human-comparable accuracy and reliability • Greater accuracy of results • Greater reliability in grading with AI • Human variations in disease level • Lack of accuracy in AI technology • Less reliable AI systems being used elsewhere • · More evidence on AI accuracy
Impact on societal change • AI against human rights	Media coverage around AI • Negative media coverage around AI • Misleading media information

knowledge about AI's functionality within the DESP, including how AI detects lesions and the learning process behind AI systems.

HCP voiced concerns about the rapid evolution of AI, stressing the need for AI systems to evolve alongside new research findings and clinical approaches. *"AI systems will need to keep in step with new findings in research, and referral outcome approaches of graders and clinicians."* (Male, 34, screener/grader, white).

3.1.3. Impact on the workforce

PLD were concerned about potential job losses among those working in the DESP due to AI. The potential for AI to lead to privatisation also sparked worry, particularly regarding its impact on the NHS workforce and funding. As one PLD noted, *"I don't want to see people sacked or demoted as a result. Also, will it be used to siphon off NHS money into big business?"* (Male, 71, T1, white).

HCP also shared concerns about their job security, particularly about the diminished opportunities for career progression and the potential for staff being replaced by AI, *"Using a computer system will [reduce] the time of us graders spent grading images meaning eventually we will no longer be required for the job."* (Female, 27, screener/grader, white). PLD worried about the broader implications of AI, including the *"risks in deskilling staff."* (Male, 67, T1, White). HCP thought similarly but also saw AI as a potential avenue for professional growth, suggesting it would, "*help staff to develop new skills on more complicated tasks that will benefit our patients."* (Male, 65, senior grader/screener, white).

PLD viewed AI as a tool to enhance NHS efficiency, suggesting that it could help direct resources to more urgent areas. Similarly, HCP recognised AI's potential to reduce workload and enhance efficiency but also expressed concern that this might be used primarily as a cost-cutting measure, leading to workforce cuts rather than reinvestment in staff skills.

HCP explicitly discussed the potential negative impact on staff morale, with some predicting that morale and motivation would *"drop right down"* (Female, 50, programme manager, white) if AI was introduced without addressing these concerns.

3.1.4. Data regulation, security, responsibility and governance

PLD expressed significant concerns about data security, including the confidentiality of medical records and the potential for system failures – "*Can mistakes be made? What if there's a glitch in the system and incorrect info is reported"* (Female, 58, T2, white). HCP also shared data security concerns and highlighted financial and operational challenges.

PLD spoke about the need for quality assurance checks of AI in screening, which was echoed by HCP who stated the importance of rigorous quality assurance processes to maintain trust in AI. They suggested that even when AI detects no DR some images should still undergo secondary grading by humans for quality assurance – "*If AI detects no DR, a percentage of these images should still progress to secondary grading- for QA [quality assurance] purposes as per human grades"* (Male, 39, screener/grader, white).

Ethical concerns, particularly regarding patient choice and responsibility, were also raised. PLD emphasised the importance of patient autonomy and the need for clear communication and consent when integrating AI into healthcare practices – *"If AI is used, the patient should be informed before the test and given the option to refuse and ask for a human*" (Female, 71, T2, mixed). One HCP questioned, *"Who is responsible for the patient if disease is missed? Will patients have the choice to not be graded by AI?"* (Female, 35, slit lamp grader, white).

3.1.5. Trust

PLD stressed the importance of human oversight in AI-driven processes, preferring that AI be used alongside rather than replacing human judgment. One PLD remarked, *"I would only ever like it to be used as an assistive technology to a qualified professional clinician."* (Male, 50, T2, white). One participant even referred to AI *"as a backup"* (Female, 60, T2, white). HCP also highlighted the need to gradually build trust and confidence in AI among healthcare staff through careful, phased implementation. One HCP suggested that *"it would be good for the staff to use the AI system amongst ourselves… before we begin using it on patients."* (Female, 28, optometrist and grader, Asian).

For PLD, trust in AI was closely tied to clear communication and transparency from healthcare providers. They felt that *"lack of information results in mistrust and resentment*" (Female, 69, T1, white) and reassurance from professionals would help to build confidence in AI. HCP recognised that AI errors could affect both patient and staff confidence. One HCP even stated, *"a lot of care needs to be taken to ensure trust is not lost between DESP's, patients, and HES [Hospital Eye Service] staff."* (Male, 39, screener/grader, white). However, they also saw the potential for AI to gain trust through effective control, regulation, and gradual adoption. One HCP noted, *"AI has the potential to work successfully if controlled and regulated effectively*" (Male, 41, screener/grader, white).

3.1.6. Human involvement, screening experience, and patient and practitioner relationship

A prevalent misconception, among both PLD and HCP, was around how the introduction of AI would affect the DESP screening experience, with many thinking there would not be any PLD and HCP interactions during the screening visit.

Many PLDs stressed the importance of human contact and interaction in healthcare, expressing a strong preference for dealing with people rather than machines. One PLD commented, *"I fear that AI will be a dehumanising step increasing the divide between patient and service."* (Female, 74, T2, white). Others reflected on the emotional support and empathy that human interactions provide stating that *"speaking to a person is reassuring, especially when dealing with diabetes"* (Female, 51 T2, Black) and how the presence of a clinician can *"help you feel comfortable and calm"* (Female, 51 T2, Black). HCP shared these concerns, one HCP succinctly stated *"AI may encourage us to treat people as a list of symptoms. Are we risking dehumanising our patients?"* (Female, 52, senior grader/screener).

Despite recognising AI's potential benefits, PLD emphasised the need for ongoing human involvement in the screening process. Many believed that the *"human touch will always be best"* (Female, 66, T2, white) particularly in ensuring that HCP remain responsible for final checks and patient interactions. HCP agreed that human contact is essential, especially in explaining results to patients – *"as good as AI can be, it can never replace human knowledge or experience. It cannot talk or explain to patients about their results"* (Female, 49, senior screener/grader, white).

PLD valued personal relations in the current DESP associating them with reassurance and positive healthcare experiences. One PLD shared, *"I've always enjoyed the yearly interactions with the healthcare professionals and the reassurance of a letter arriving with hopefully positive news"* (Female, 64, T2, white). However, some PLD advocated for modern, cost-effective communication methods, such as email or text.

Both PLD and HCP expressed a strong preference for maintaining

human oversight in AI-driven processes. HCP emphasised that AI *"shouldn't wholly replace human graders but [act as] a useful tool to work with humans,"* (Male, 27, screener/grader, Mixed or Multiple Ethnic groups). The consensus among HCP was that AI can enhance efficiency and support human graders, particularly for routine tasks, while complex cases should remain under human oversight.

3.1.7. Practicalities of AI implementation

Some PLD were wary that AI might be introduced primarily as a *"cost-cutting venture"* (Female, 72, T2, white) and felt it was *"a good idea so long as it's not just to save money"* (Female, 66, T2, white). However, there was also optimism that AI could *"speed up results and reduce costs"* (Male, 56, T2, white) suggesting a belief in its potential efficiency benefits.

HCP were more sceptical about the financial benefits, pointing out the high costs associated with implementation, maintenance, and security of AI systems. They worried that AI might not provide good value for money. HCP also raised concerns that AI might not necessarily enhance patient capacity but instead lead to budgetary savings at the expense of service expansion –*"I think the reality of healthcare organisations mean that any time saved/efficiencies caused by introducing AI grading would not increase capacity for patient care, but would result in cost savings"* (Female, 43, programme manager, white).

PLD emphasised a cautious and gradual introduction of AI, advocating for a blended approach where AI works alongside humans initially. This was suggested as some PLD *felt "trust will take time to build up"* (Female, 67, T2, white). Like PLD, HCP also favoured a gradual implementation of AI, stressing the need for continuous evaluation and improvement. There was support for initially having human graders work alongside AI to ensure a smooth transition, *"the introduction of AI is inevitable, it's just a matter of how it is done. Hopefully it will be gradually introduced in parallel while it continues to improve to a satisfactory standard."* (Male, 55, senior screener/grader, white).

3.1.8. Efficiency

Both PLD and HCP recognised the potential for AI to enhance efficiency. They agreed that AI could speed up processes, particularly in screening and grading tasks. Both groups also stressed the importance of human involvement in the process, especially when dealing with complex or atypical cases – *"AI would increase the speed and efficiency of the screening/grading process and hopefully be as accurate, reliable, and fully assured as human grading."* (Female, 40, senior screener/grader, white).

PLD generally favoured a hybrid model where AI handles initial screenings, with humans making the more complex judgments. They saw AI as a tool to complement, not replace, humans. HCP emphasised AI's capacity to efficiently manage large volumes of data, potentially improving overall workflow and resource allocation. They envisioned AI as a way to free up human resources for other critical tasks within the department.

3.1.9. Inequalities

PLD emphasised the need for assurances that AI will benefit all patients equitably, and expressed concern that certain groups may face barriers to understanding and accessing AI-driven technology – "*I believe that people who are retired have a problem understanding AI and this causes apprehension and doubt in AI to take the place of qualified practitioners"* (Male, 66, T2, white). PLD advocated for more research to understand the effectiveness and impact of AI in various population subgroups, calling for more information on ethnic and age differences. HCP were also concerned about potential biases in AI algorithms, particularly regarding ethnicity. One HCP noted, *"AI and AI-based algorithms are biased towards those with a darker pigment,"* (Female, 37, administrator manager, Mixed or Multiple Ethnic group).

3.1.10. Accuracy and reliability of AI technology

PLD were concerned about the accuracy and reliability of AI in medical diagnosis. They emphasised the need for extensive testing and validation before AI can be fully trusted. One PLD stated, *"I think the AI it's the future, but we have to confirm its accuracy"* (Female, 54, T2, white).

HCP expressed varied opinions on the accuracy and reliability of AI technology. One HCP emphasized the need for transparency in AI training and validation, stating, *"I would want to see how the AI system worked and get information on how the system learning has been achieved before I can make any qualified decisions on whether this would be a good alternative to human grading"* (Male, 48, screener/grader, white).

Conversely, some HCP were optimistic about AI's potential to improve screening accuracy and consistency. They also believed AI could reduce human errors caused by fatigue and repetitive tasks, with one HCP noting, *"AI will be more consistent and reduce errors in primary queue due to repetitive grading fatigue and trying to keep grading queues down while in clinic*" (Male, 32, screener/grader, white).

3.1.11. Impact on societal change

PLD raised concerns about AI intervention in healthcare, fearing it might violate human rights. One PLD remarked, *"AI intervention will be totally against one's human rights. There is no room for errors with this technology as we have only one pair of eyes" (Female, 72, diabetes type not stated, Black).*

Some PLD were concerned about the broader societal changes AI might bring, fearing job displacement and the loss of human-centred values. One PLD expressed, *"I want jobs for humans… I do not want to live in a fully automated society"* (Female, 51, T2, white).

3.1.12. Media coverage around AI

A few HCP felt media coverage significantly shaped public perceptions of AI, often leading to misconceptions. As one HCP noted, *"AI is a powerful tool if trained and used correctly. Unfortunately, most people do not understand how AI systems work, or have misleading opinions due to the media"* (Female, 35, administrator, white). Another added, *"There is too much negative press currently re. AI to adopt it into the DESP"* (Female, 61, screener/grader, white).

4. Discussion

To our knowledge, this is the largest survey to examine perceptions around use of AI for diabetic eye screening and explores views of PLD and HCP towards AI and its possible implementation into the DESP. Of the total survey respondents, approximately 24 % of PLD and 37 % of HCP provided a comment, which were reviewed as part of this analysis.

The narrative around AI in healthcare screening is complex, reflecting a spectrum of opinions shaped by personal and professional experiences. While some expressed scepticism and concern over AI's limitations and potential risks, others embraced its promise and inevitability, this was the case across all respondents in terms of ages and ethnic groups.

For many, the integration of AI into the DESP was viewed as an exciting development with the potential to improve diagnostic efficiency and reduce costs. However, there is a clear consensus on the need for a balanced, gradual implementation that maintains the "human element" in patient care. A prevalent theme, for both PLD and HCP, was the misconception regarding how the current screening experience would change with the introduction of AI into the DESP. Although AI would be used to grade retinal images, the screening experience and patient journey would remain unchanged. Both PLD and HCP stressed the importance of clear communication, and human oversight to build trust and ensure the successful adoption of AI in healthcare.

These views highlight the need to educate PLD and HCP around AI and how it would be deployed in the DESP, potentially through educational material. This reinforces previous research which also highlighted a need to educate and empower HCP around AI in healthcare [19]. There is also a specific need to educate individuals about AI performance, especially since, for more severe diabetic eye disease, AI has been shown

to perform as equitably as a human [4,5].

The integration of AI into the DESP was seen as a potential advantage for the NHS, reducing staff workload, reallocating resources effectively, and improving system efficiency. However, for successful implementation, it is imperative to address potential concerns, a priority also highlighted by The Health Foundation, in an article published this year on AI in healthcare [8]. Exactly how AI is implemented in the DESP remains an important factor and needs to be carefully managed moving forward. A misstep in AI integration into the DESP could potentially undermine patient confidence, erode trust in the healthcare system and exacerbate existing health inequalities. Effective regulation and control are essential to ensure AI's success and maintain public trust. Clear communication, robust education, and extensive research are essential to build confidence and understanding for both PLD and HCP to embrace AI adoption in diabetic eye screening.

The collaborative use of AI and human technicians in the DESP is seen as a promising strategy to improve both the speed and accuracy of diabetic eye screening and was greeted with greater confidence than AI alone, as identified in previous studies [20,21]. PLD appreciated the efficiency and reliability that AI could provide to the initial assessment, while valuing the critical judgment and expertise that HCP contribute to interpreting and validating results. This balanced approach addresses concerns about over-reliance on technology while utilising the strengths of both AI and HCP to enhance patient care.

Media representations often skew perceptions, portraying AI as either overly capable or flawed. Clarifying that current AI systems, in the context of diabetic eye screening, function primarily through pattern recognition and prediction, rather than possessing true artificial intelligence (i.e., not learning and evolving), is crucial for greater understanding for both PLD and HCP and could build confidence and trust in AI integration into the DESP.

5. Strengths and limitations

This study has several strengths and limitations in the context of AI research. One significant strength is that previous AI surveys have focussed on quantitative survey data, whereas this study focussed on detailed insights from qualitative data. This approach allowed for the identification of themes that may not have been captured by the survey and elicited additional perceptions around AI in diabetic eye screening. Another strength of this work was capturing the perceptions of both HCP and PLD, with an opportunity to compare both sets of viewpoints. The independent coding employed in the analysis phase enhanced the reliability and validity of the findings. Furthermore, the high volume of comments demonstrated substantial public interest in this topic, and strong engagement across various demographic groups (including different ages and ethnicities), which ensured a wide range of perspectives were represented.

Limitations include potential selection bias from the optional free-text box, where respondents with strong opinions on AI may be over-represented, leading to views that may not reflect the wider population. In addition, participants' opinions could also have been shaped by media coverage of AI, affecting response authenticity. The survey's requirement for English literacy limited participation from non-English speakers and those with low literacy and the online format may have excluded people with diabetes without internet access or devices. Additionally, the younger age of HCP respondents compared to PLD could potentially influence perceptions of technology.

5.1. Conclusion

Preliminary quantitative and qualitative findings from the survey have raised issues that need to be addressed prior to AI implementation, in particular, a lack of understanding around how AI will be used within the DESP, concerns over a less personalised screening experience, and issues over trust and AI performance. It is therefore imperative to understand the educational needs of PLD and HCP before AI is introduced into the DESP to ensure a smooth transitional process and to build trust. Education-based approaches in other areas of diabetes management have been shown to improve outcomes among PLD [22]. Creating outreach initiatives such as an education-based programme for both PLD and HCP is an important prerequisite to introduce new technologies into clinical practice, and this is of particular importance regarding the integration of AI into healthcare pathways and processes. Additional interventional or comparative trials could be beneficial in evaluating the effectiveness of educational interventions, such as workshops or online modules, for PLD and HCPs.

CRediT authorship contribution statement

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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References

[1] Tufail A, et al. Automated diabetic retinopathy image assessment software: Diagnostic accuracy and cost-effectiveness compared with human graders. Ophthalmology 2017;124(3):343–51.
[2] Tufail A, et al. An observational study to assess if automated diabetic retinopathy image assessment software can replace one or more steps of manual imaging grading and to determine their cost-effectiveness. Health Technol Assess 2016;20 (92):1–72.
[3] Zhelev ZPJ, Rogers M, et al. Automated grading in the diabetic eye screening programme: external review against programme appraisal criteria for the UK. In: National Screening Committee In: Committee UNS; 2021.
[4] Heydon P, et al. Prospective evaluation of an artificial intelligence-enabled algorithm for automated diabetic retinopathy screening of 30 000 patients. Br J Ophthalmol 2021;105(5):723–8.
[5] Rudnicka A, et al. Evaluation of equity in performance of Artificial Intelligence for diabetic retinopathy (DR) detection. Invest Ophthalmol Vis Sci 2024;65(7):4922.
[6] Schünemann HJ, et al. GRADE guidelines: 22. The GRADE approach for tests and strategies-from test accuracy to patient-important outcomes and recommendations. J Clin Epidemiol 2019;**111**:69-82.
[7] Taylor-Phillips S, et al. UK National Screening Committee's approach to reviewing evidence on artificial intelligence in breast cancer screening. Lancet Digit Health 2022;4(7):e558–65.
[8] The Health Foundation – Thornton N, Binesmael A, Horton T, Hardie, T. AI in health care: what do the public and NHS staff think? 2024.
[9] Nix M, Onisiforou G, Painter A. Understanding healthcare workers' confidence in AI. 2022; Available from: https://digital-transformation.hee.nhs.uk/binaries/content/assets/digital-transformation/dart-ed/understandingconfidenceinai-may22.pdf.
[10] Keel S, et al. Feasibility and patient acceptability of a novel artificial intelligence-based screening model for diabetic retinopathy at endocrinology outpatient services: a pilot study. Sci Rep 2018;8(1):4330.
[11] Gao S, et al. Public perception of artificial intelligence in medical care: content analysis of social media. J Med Internet Res 2020;22(7):e16649.
[12] Aggarwal R, et al. Patient perceptions on data sharing and applying artificial intelligence to health care data: cross-sectional survey. J Med Internet Res 2021;23 (8):e26162.
[13] Fritsch SJ, et al. Attitudes and perception of artificial intelligence in healthcare: a cross-sectional survey among patients. Digital Health 2022;8: 20552076221116772.
[14] Young AT, et al. Patient and general public attitudes towards clinical artificial intelligence: a mixed methods systematic review. Lancet Digit Health 2021;3(9): e599–611.
[15] Stai B, et al. Public perceptions of artificial intelligence and robotics in medicine. J Endourol 2020;34(10):1041–8.
[16] Yap A, et al. Patients perceptions of artificial intelligence in diabetic eye screening. Asia Pac J Ophthalmol (Phila) 2022;11(3):287–93.
[17] Willis K, et al. What are the perceptions and concerns of people living with diabetes and National Health Service staff around the potential implementation of AI-assisted screening for diabetic eye disease? Development and validation of a survey for use in a secondary care screening setting. BMJ Open 2023;13(11):e075558.
[18] Kathryn Willis RS, Lakshmi Chandrasekaran, Umar Chaudhry, Charlotte Wahlich, Ryan Chambers, Louis Bolter et al. What are the perceptions and concerns of people living with diabetes and National Health Service staff around the potential implementation of AI-assisted screening for diabetic eye disease. In submission; 2024.
[19] Bajwa J, et al. Artificial intelligence in healthcare: transforming the practice of medicine. Future Healthc J 2021;8(2):e188–94.
[20] Haan M, et al. A qualitative study to understand patient perspective on the use of artificial intelligence in radiology. J Am Coll Radiol 2019;16(10):1416–9.
[21] Lennox-Chhugani N, et al. Women's attitudes to the use of AI image readers: a case study from a national breast screening programme. BMJ Health Care Inform 2021; 28(1).
[22] Loveman E, Frampton GK, Clegg AJ. The clinical effectiveness of diabetes education models for Type 2 diabetes: a systematic review. Health Technol Assess 2008;12(9). pp. 1–116.