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Implementing risk stratification in UK glaucoma services: a qualitative study of barriers and facilitators

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Abstract

Background / Objectives: Rising demand for glaucoma services has intensified the need for effective prioritisation of patients according to clinical risk. This study explored clinicians' perspectives on glaucoma risk stratification and identified barriers and facilitators to implementing stratification systems within UK glaucoma services.

Subjects / Methods: A qualitative study using semi-structured interviews was conducted with ophthalmologists, allied health professionals, and service managers involved in glaucoma care. Participants were recruited using purposive sampling. The interview topic guide was informed by the Theoretical Domains Framework, and transcripts were analysed using inductive thematic analysis.

Results: Eighteen participants from nine institutions were interviewed. Four major themes were identified: (1) reflections on glaucoma management and the role of risk stratification; (2) barriers to implementation; (3) facilitators supporting adoption; and (4) perceived benefits of risk stratification. Key barriers included the clinical heterogeneity of glaucoma, limitations in electronic medical record systems, time constraints, and variation in organisational support. Facilitators included educational initiatives, embedding stratification within electronic patient records, leadership endorsement, and demonstrating measurable service benefits. Participants highlighted potential advantages including improved prioritisation of high-risk patients, more efficient allocation of clinical resources, and potential for enhanced patient safety.

Conclusions: Systematic risk stratification is perceived as valuable for improving glaucoma service delivery; however, successful implementation requires coordinated technological, organisational and behavioural change. Embedding stratification within digital systems, supported by education, leadership and robust evidence, will be critical to achieving sustainable adoption within routine clinical practice.

WHAT WAS KNOWN BEFORE

- Risk stratification is advocated to improve efficiency in UK glaucoma services.
- Several stratification tools exist, but uptake in routine clinical practice is variable.
- Implementation of new healthcare models is often limited by organisational, behavioural and technological barriers.

WHAT THIS STUDY ADDS

- New insights into clinicians' perspectives on implementing systematic glaucoma risk stratification within UK services.
- Identifies key multi-level determinants of implementation, including workforce pressures, digital infrastructure, and organisational support.

- Highlights the importance of embedding stratification within EMR systems, alongside education, local champions, and a stronger evidence base to support adoption.

INTRODUCTION

Risk stratification has become a cornerstone of population health management and personalised medicine [1]. Advances in the routine collection of clinical and demographic data, particularly through electronic medical records (EMRs), have enabled more precise alignment of healthcare delivery with patients' level of need [2]. At the same time, rising demand has increased expectations that clinical services adopt stratified and predictive approaches to care, particularly in specialties managing large patient caseloads [3].

Glaucoma represents a clinical population where risk stratification may be particularly valuable. The condition is characterised by heterogeneous disease progression, with substantial variation in patients' risk of experiencing visual impairment and long-term functional disability [4, 5]. While some individuals remain stable with minimal intervention, others may experience more progressive or complex disease requiring closer monitoring and timely escalation of treatment [6]. Identifying those at greatest risk of impairment is therefore essential to support safe and efficient allocation of healthcare resources.

Traditional approaches to stratifying glaucoma have focused on structural and functional measures of disease severity, most commonly visual field mean deviation assessed using standard automated perimetry, where several staging systems have been proposed [7–10]. More recently, service-oriented models have been developed to support clinical pathway design, such as UK-based protocols that link patient risk profiles to specific clinic types [11]. The Glauc-Strat-Fast tool builds on this approach, applying a traffic-light system that incorporates both clinical and contextual factors which influence disease complexity [12]. Use of the measure has been endorsed by the Royal College of Ophthalmologists [13] and research has demonstrated its predictive validity in relation to treatment escalation and disease progression in patients with ocular hypertension and open-angle glaucoma [14]. Retrospective analyses have also shown its utility in informing prioritisation of care and managing service backlogs [15, 16]. Although these studies provide evidence supporting the clinical utility of risk stratification, less is known about the factors influencing its adoption and sustained use within routine glaucoma services.

Implementation of new tools into routine clinical practice is inherently complex. Adoption is influenced by a combination of operational constraints, organisational culture, and professional behaviour [17], particularly in services facing high demand and workforce pressures, such as glaucoma. The aim of this study was to explore clinicians' perspectives on glaucoma risk stratification and to identify barriers and facilitators to implementing systematic stratification systems within UK glaucoma services.

METHODS

Study design

This qualitative study used semi-structured interviews to explore clinicians' perspectives on systematic glaucoma risk stratification and factors influencing its implementation. The topic guide was developed using the Theoretical Domains Framework (TDF), which identifies behavioural determinants of professional practice [18]. The TDF was used to guide the development and structure of interview questions, while the subsequent analysis was conducted inductively.

Participants and recruitment

Purposive sampling was used to recruit participants with experience in glaucoma care or service management. Eligible participants included ophthalmologists, allied health professionals involved in glaucoma care (optometrists or orthoptists), and hospital service managers. Participants were identified through professional networks and relevant ophthalmology societies and invited via email.

Data collection: Interviews were conducted online using Microsoft Teams between July 2023 and January 2024 by a trained researcher with a background in health psychology (LJ). The interview topic guide explored participants' knowledge of glaucoma risk stratification, perceptions of its usefulness, and factors influencing its implementation (Table 1). Interviews were audio-recorded with participants' consent and transcribed verbatim. The study was approved by the London - Chelsea Research Ethics Committee (ref: 17/LO/1664) and conformed to the tenets of the Declaration of Helsinki.

Table 1
Examples of interview questions informed by the Theoretical Domains Framework.

Knowledge
What can you tell me about risk stratification in glaucoma?
How does risk stratification in glaucoma compare to other health conditions?
Skills / Beliefs about capabilities
How easy or difficult would you find acting on recommendations to stratify glaucoma patients?
Perceptions
To what extent is glaucoma risk stratification being done where you work?
Beliefs about consequences / Goals
What are the potential outcomes of glaucoma risk stratification for (1) you, (2) patients and (3) hospitals?
Environmental resources / Behaviour retention
What local/environmental factors help or hinder glaucoma stratification?
How can risk stratification be achieved and maintained across the glaucoma service?

Data analysis

Data were analysed using thematic analysis following the approach described by Braun and Clarke [19]. Transcripts were read for familiarisation and coded inductively at a semantic level by one researcher (LJ). Codes were grouped into themes representing patterns across the dataset. Theme development was discussed with the wider research team to support the interpretation of the findings. Data were managed using NVivo software (QSR International, Cambridge, Massachusetts, USA). Recruitment ceased when successive interviews were no longer generating substantially new information relevant to the study objectives.

RESULTS

Eighteen participants were interviewed (*n* = 14 ophthalmologists; *n* = 3 allied health professionals; *n* = 1 service manager). Participants were based across nine institutions and had extensive experience working within UK glaucoma services. Average interview duration was 38 (± 21) minutes. Four major themes were identified: (1) reflections on glaucoma management and the role of risk stratification, (2) barriers to implementation, (3) facilitators supporting implementation, and (4) perceived benefits of stratification.

Theme 1: Reflections on glaucoma management and the role of risk stratification

Participants described glaucoma services as operating under significant strain, characterised by high patient caseloads and increasing demand. Participants recognised the importance of prioritising patients according to their risk of visual impairment, and risk stratification was viewed as a potentially valuable approach to supporting more efficient and clinically appropriate allocation of care. Participants highlighted that glaucoma encompasses a wide spectrum of disease trajectories, and this variability reinforced the importance of identifying patients at highest risk:

"Because glaucoma is such a wide disease… we need to know who these high-risk patients are because they're the ones that we need to be far more interventional on." (010 - Ophthalmologist)

Stratification was described as enabling differentiation between patients who could be managed in lower-intensity settings, such as virtual or community-based clinics, and those requiring more specialist consultation. However, participants acknowledged that, in practice, stratification had historically been inconsistent or informal. Previous approaches were described as lacking standardisation, with variation both within and between institutions:

"It's not a language we use in glaucoma. Every consultant has their own system." (005 - Ophthalmologist)

This inconsistency contributed to perceived inefficiencies in service delivery, including inappropriate allocation of patients to clinic types, resulting in duplication of appointments and additional burden on already pressured services:

"You see someone in a virtual clinic who shouldn't be there, they've taken up a virtual clinic slot, but then they need to be rebooked into a face-to-face clinic, so that's two appointments that have been taken." (015 – Optometrist)

Participants were familiar with the Glauc-Strat-Fast tool and generally viewed it as a promising approach to standardising risk stratification. The traffic-light classification system was widely perceived as intuitive and accessible, particularly for clinicians with less specialist experience:

"It gives the general ophthalmologists or even general doctors guidelines of how to proceed because if you are not very experienced with glaucoma, you don't really know which case is urgent and which is not." (013 – Ophthalmologist)

Views on the tool's readiness for implementation were mixed. Some participants questioned whether it offered meaningful advantages over existing approaches based on visual field assessment:

"If you go from green to red, it's because your decibel loss is from four to eight." (004 - Ophthalmologist)

Others conceptualised the tool more broadly as a framework for estimating clinical complexity and resource requirements, rather than a predictive model of disease progression:

"It's a way of saying this is where the patient is and here's the likely level of resource you'll need… you can model it." (001 - Ophthalmologist)

Overall, while risk stratification was widely recognised as necessary, participants highlighted ongoing uncertainty regarding how best to operationalise it within routine clinical practice.

Theme 2: Barriers to implementation

Participants identified multiple barriers impacting effective risk stratification, spanning clinical, organisational and system-level factors. A fundamental challenge related to the inherent complexity and heterogeneity of glaucoma. Participants explained how the disease does not lend itself easily to standardised classification due to the wide range of clinical presentations and influencing factors:

"There's such a huge spectrum of disease, and as a result, there's so many different risk factors… There's so many things that we have to think about." (015 – Optometrist)

This complexity was compounded by limitations in the availability of essential clinical data. Accurate stratification was seen to depend on reliable visual field testing and comprehensive patient information; however, participants described difficulties in accessing timely and high-quality data in routine practice:

"We couldn't get visual fields on our patients for about six months, and then the quality of the fields themselves would be poor… these are real-world barriers to stratification." (001 - Ophthalmologist)

Absence of a definitive metric for glaucoma severity was perceived to increase uncertainty in classification, particularly compared to other ophthalmic conditions where imaging biomarkers provide more standardised measures:

"Glaucoma is unique because we don't have a single metric, unlike AMD which is a really well stratified cohort. If you don't have a single measurement you're already introducing complexity. I think that makes stratification really challenging." (016 – Orthoptist)

Time constraints and workload pressures were consistently reported as major barriers. Participants described busy clinical environments in which even small additional tasks could be difficult to accommodate:

"It's only two minutes, but if you see 15 patients, that starts adding up." (003 - Ophthalmologist)

This highlighted how even relatively small additional tasks could become burdensome when repeated across large patient caseloads, potentially discouraging routine use of stratification tools.

Burnout was also identified as a factor potentially limiting clinician engagement with new initiatives:

"For the burnt-out clinician the last thing they're going to do is stratify somebody." (001 - Ophthalmologist)

Additional structural challenges included staffing shortages, service pressures, and ongoing organisational change. Limited organisational support for risk stratification was perceived to hinder implementation, particularly where it was not prioritised.

Finally, digital infrastructure was a further barrier. Participants reported challenges related to EMRs, including incomplete data, lack of interoperability between systems, and variability in digital maturity across NHS organisations:

"Digital maturity across the NHS is a massive barrier to doing stratification well and at scale." (016 – Orthoptist)

Theme 3: Facilitators supporting adoption

A range of factors could support the successful implementation of systematic glaucoma risk stratification, encompassing education, system design, behavioural integration, organisational support and wider professional endorsement. These facilitators were framed in terms of reducing burden, increasing perceived value, and embedding stratification within routine clinical practice.

A key facilitator was improving awareness and understanding of risk stratification, particularly in relation to its impact. Participants emphasised that clinicians need to understand why it is important for patient outcomes and service delivery:

"We are not educating people enough about it. We need to give the full path, not only stratification output, but how stratification is going to improve outcomes. We need to show that." (009 - Ophthalmologist)

In addition, participants highlighted the importance of demonstrating the practical outputs of stratification systems. Generating meaningful data, such as the distribution of patients across risk categories or benchmarking against other services, was seen as a way to incentivise engagement:

"You'd want some kind of output, how many red high risk patients you've got, how many green low risk… If there are useful outputs then people will make the effort to put the input in on the other end." (006 - Ophthalmologist)

It was emphasised that stratification must be embedded within existing digital workflows and incorporated into routine practice, rather than relying on retrospective or manual processes:

"Because everything's computerised now, it has to be within the system otherwise doctors will forget. It has to be embedded in the system that the hospitals use." (013 - Ophthalmologist)

Integration within existing clinical workflows was therefore viewed as important for reducing additional workload and supporting consistent use. Automation was considered to have a role in this process,

where the potential for artificial intelligence (AI) to support automated or semi-automated stratification was recognised, particularly as digital systems become more advanced:

"When electronic medical records become more sophisticated, it wouldn't take much AI to actually stratify a glaucoma patient. So it could all be done automatically in future." (004 - Ophthalmologist)

The role of local champions was also considered important, with participants suggesting that individuals who actively promote and advocate for stratification within their departments could play a role in driving adoption and sustaining engagement:

"It's important to have an ambassador… someone who's really passionate about it, to drive it." (012 – Service Manager)

Alongside local champions, participants emphasised the importance of organisational leadership in establishing the structures and resources needed to support implementation, rather than relying solely on individual clinician engagement:

"Until the organisational structure is set up… you need support from above." (004 - Ophthalmologist)

In addition, stratification was seen as having potential to be integrated into service-level performance metrics, enabling monitoring and evaluation of implementation at an organisational level:

"It can be measured… how many risk stratifications have we done? What's the outcome?" (012 – Service Manager)

At a broader level, endorsement from professional bodies was seen as a key facilitator. Recognition by organisations such as the Royal College of Ophthalmologists was perceived to legitimise stratification and support its adoption across services:

"Now it's endorsed… that's the first step to generalised acceptance." (006 - Ophthalmologist)

Finally, participants highlighted the importance of continued research and development. A lack of robust evidence demonstrating the impact of stratification was perceived as a barrier to wider adoption, alongside the need for ongoing refinement of tools to ensure flexibility across diverse clinical scenarios:

"Maybe that's the biggest problem… the lack of evidence that it helps and makes a difference." (011 - Ophthalmologist)

"It needs to be proved as a concept… so people can say, well why wouldn't I do it?" (012 – Service Manager)

Theme 4: Perceived benefits of risk stratification

At service level, risk stratification was viewed as a mechanism to improve clinic organisation and efficiency. Participants described how grouping patients according to risk could create more predictable clinic structures and improve workflow:

"It's quite difficult to do a clinic where one patient takes an hour, the next one takes six minutes… but if you are doing a stable clinic, you know they're all going to be quick, and it just flows." (008 - Ophthalmologist)

Stratification was considered valuable in managing service disruptions, such as clinic cancellations or backlogs. Participants described how risk-based categorisation could support rapid decision-making without requiring detailed review of individual patient records:

"If you label red, amber, green… you can say, let's get rid of all the greens straightaway. You don't even need to go through the notes." (014 - Ophthalmologist)

More efficient allocation of resources was another anticipated benefit. Participants reported how stratification could support more efficient use of the multidisciplinary workforce by aligning patient complexity with appropriate levels of care:

"The service works better where patients are risk stratified… it allows you to allocate them to the right clinic and the right person." (008 - Ophthalmologist)

From a clinical perspective, patient safety was a salient consideration. Participants expressed concern that high-risk patients may be overlooked within large patient populations if systematic prioritisation is not in place. Stratification was therefore seen as a mechanism to ensure timely review of those most at risk:

"The main benefit would be that they get seen at the correct time for their condition… so someone doesn't get inadvertently delayed." (008 - Ophthalmologist)

Participants also noted benefits for lower-risk patients, who could be managed in less intensive settings, including community-based or virtual clinics. This was seen as improving access to care while reducing hospital visits:

"Even the lower-risk patients benefit, because they can be seen closer to home rather than in busy hospital clinics." (011 - Ophthalmologist)

Participants also anticipated potential economic benefits through improved service efficiency and reduced long-term costs associated with disease progression:

"It saves money in the long-term… because we are managing care better and streamlining the service." (009 - Ophthalmologist)

In addition to organisational and clinical advantages, participants described psychological benefits. For clinicians, the use of a structured stratification system was seen as providing reassurance and

supporting decision-making:

"It provides clinician confidence… there's something to support that decision-making, an evidence base." (016 – Orthoptist)

Overall, risk stratification was viewed as offering substantial benefits across multiple levels of the healthcare system, provided it can be implemented safely, effectively and consistently.

DISCUSSION

This study explored clinicians' perspectives on glaucoma risk stratification and identified barriers and facilitators influencing its implementation in UK glaucoma services. Participants recognised the importance of systematic risk stratification and described existing, albeit inconsistent, approaches to categorising patients according to disease severity and complexity. However, despite broad support for stratification, views differed regarding the added value of specific tools, and implementation was influenced by clinical, organisational and technological factors.

Workforce pressures were a prominent barrier to implementation. Time constraints, staffing shortages and increasing service demand were described as limiting clinicians' capacity to adopt new processes, consistent with wider implementation research [20, 21]. These challenges are particularly relevant to ophthalmology, where increasing demand has outpaced the availability of trained specialists [22, 23]. New models of care, including expanded roles for allied health professionals, virtual clinics and community monitoring schemes, have been introduced to improve capacity and efficiency [24–27]. Risk stratification could complement these approaches by directing patients to appropriate care pathways according to clinical risk and complexity, supported by guidance linking risk categories with provider competencies across primary and secondary care [28].

Similar barriers have been reported in the implementation of other healthcare improvement initiatives including telemedicine, integrated care pathways, and antimicrobial stewardship, where workforce capacity, resistance to change and infrastructure constraints can limit adoption [29–32]. Clinician burnout, which is prevalent among ophthalmologists [33], may further reduce engagement with new initiatives. Our findings suggest that even relatively small additional tasks may be perceived as burdensome within pressured services, particularly where their benefits are not immediately apparent or effectively communicated. Implementation strategies should therefore minimise additional workload and demonstrate clear value to clinicians and services.

Digital infrastructure was another important determinant of implementation. Participants identified incomplete clinical data, limited interoperability and variation in EMR capabilities as barriers, consistent with wider evidence that technological limitations can impede changes in healthcare delivery [21]. Integrating risk stratification within existing EMR systems, potentially supported by automation or AI, was viewed as an opportunity to reduce manual processes and support consistent application. Recent guidance from the Royal College of Ophthalmologists emphasises the need for structured, interoperable

ophthalmic datasets [34], while standardised glaucoma datasets provide a potential foundation for integrating tools such as Glauc-Strat-Fast into routine clinical workflows [35]. However, the feasibility, reliability and clinical safety of automated stratification approaches require further evaluation.

Despite national initiatives to improve digital infrastructure, including those set out in the 2025 NHS 10 Year Health Plan [36], progress remains uneven. Findings from the NHS Digital Maturity Assessment indicate that many trusts are not fully utilising EMR functionality [37, 38], highlighting the scale of the challenge. In this context, local experience of implementation, such as the use of Glauc-Strat-Fast at University Hospitals Birmingham, may serve as useful models for wider adoption, although transferability across services with differing resources and digital capabilities requires evaluation. Scaling these "pockets of best practice" could support more consistent implementation across the NHS and generate evidence of impact.

Education, local champions and organisational leadership were identified as complementary facilitators. Participants emphasised the importance of understanding not only how to apply risk stratification, but also its potential benefits for patients and services. Previous research highlights the importance of practice-based education and reinforcement in supporting changes to clinical practice [39, 40]. Local champions may help promote engagement and sustain implementation, consistent with evidence of their influence on the adoption of evidence-based practices [41]. Similar approaches have been applied in digital health transformation initiatives, including the Topol Digital Fellowships [42]. Together, these findings suggest that education should be accompanied by local leadership and organisational support to embed stratification within routine care.

A stronger evidence base is also needed to support systematic risk stratification in glaucoma care. For example, Glauc-Strat-Fast has undergone validation in patients with ocular hypertension and mild to moderate open-angle glaucoma, although further evaluation is required in advanced or rapidly progressing disease [14]. Sophisticated prediction models, including those developed from the Ocular Hypertension Treatment Study and European Glaucoma Prevention Study, have demonstrated predictive utility [43]. However, NICE has not recommended their routine use, highlighting limitations in the available evidence for glaucoma risk prediction tools [44]. Subsequent validation in a large UK cohort demonstrated limited predictive performance, with modest improvements following model refinement [45]. While these models serve different purposes from service-oriented stratification tools, they illustrate the importance of establishing clinical validity before wider adoption. Our findings further highlight the need to demonstrate whether implementing stratification improves patient prioritisation, service efficiency and clinical outcomes, beyond the predictive performance of individual tools.

This study provides insights from professionals across nine UK institutions, capturing perspectives on the practical challenges of implementing glaucoma risk stratification. However, the sample was predominantly composed of ophthalmologists, with fewer allied health professionals and service managers represented. Recruitment through professional networks may also have favoured individuals

with an existing interest in risk stratification or service development. Furthermore, the findings reflect participants' perceptions, and the anticipated benefits of stratification were not directly evaluated.

In conclusion, risk stratification was widely perceived as valuable for improving glaucoma service delivery, although its implementation faces important clinical, organisational and technological challenges. Tools such as Glauc-Strat-Fast offer a structured approach to patient prioritisation, but sustained adoption is likely to depend on integration within existing workflows, education, organisational support and evidence of measurable benefits. Future research should evaluate implementation strategies and their impact on service delivery and patient outcomes.

Declarations

CONFLICT OF INTEREST:

The authors declare no competing interests.

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None

AUTHOR CONTRIBUTIONS:

LJ contributed to the study design, conducted the interviews, analysed the data and drafted the manuscript. FS and PS contributed to the study design, analysis of the data, and interpretation of the findings. All authors critically reviewed and approved the final manuscript.

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