

Clinical Feasibility of an Indigenous Portable Spectral-Domain Optical Coherence Tomography System (IXanner® 7VN) for Community-Based Retinal Screening: A Rural Outreach Study

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Abstract: **Background:** Early diagnosis of retinal disease remains limited in rural India because Optical Coherence Tomography (OCT) is largely confined to tertiary centres. Portable OCT systems may help bridge this diagnostic gap. **Objective:** To evaluate the feasibility and clinical utility of a portable spectral-domain IXanner® 7Vn OCT device during a community-based eye screening camp in a rural setting. **Methods:** An observation screening program was conducted at an eye camp in Sringeri, Karnataka, India, from 31 July to 1 August 2025. A total of 135 eyes were scanned using the IXanner® 7Vn portable OCT. Scan acquisition time, operational feasibility, and clinically relevant retinal findings were documented. **Results:** All scans were successfully performed in a field setting without the need for a dark room, external power supply, or internet connectivity. Average scan time was 30–40 seconds per eye. On-site review by ophthalmologists enabled immediate clinical discussion and referral planning. Early signs of diabetic maculopathy, macular degeneration, and other retinal abnormalities were identified in a significant proportion of screened individuals. The nearest conventional OCT facility for many participants was more than 80 km away. **Conclusion:** The IXanner® 7Vn portable Spectral-Domain OCT system demonstrated strong feasibility for retinal imaging in community-based screening, with its battery-operated design enabling rapid image acquisition and clinically interpretable outputs. By supporting ophthalmologists in the early detection of retinal abnormalities rather than functioning as an autonomous diagnostic tool, the device enhances outreach-based eye care models. Rural deployment confirmed high operational feasibility and meaningful clinical utility, highlighting the potential of indigenous OCT technology to improve access, reduce referral delays, and strengthen sustainable community eye care. Larger multicentre studies are warranted to validate its performance across diverse populations and healthcare environments.

Keywords: Community eye screening, diabetic maculopathy, macular degeneration, optical coherence tomography, portable OCT, public health ophthalmology, rural eye care, teleophthalmology.

1. Introduction

Avoidable blindness continues to represent a major public health challenge globally. According to the World Health

Organisation (WHO), more than 2.2 billion people worldwide live with visual impairment, and at least 1 billion of these cases are considered preventable or treatable [1].

India contributes substantially to this burden because of its large population, increasing life expectancy, and growing prevalence of chronic diseases such as diabetes mellitus [2]. Although India has established several world-class tertiary ophthalmic institutions, access to advanced retinal diagnostics remains highly uneven, particularly in rural and semi-urban regions.

Retinal disorders, including diabetic maculopathy, age-related macular degeneration (AMD), epiretinal membrane, vitreomacular interface disorders, and macular oedema, often progress silently during their early stages [3]. Delayed diagnosis may result in irreversible structural damage and permanent visual loss. Early detection is therefore critical for preserving vision and reducing the long-term socioeconomic burden associated with blindness [4].

Optical Coherence Tomography (OCT) has become the gold standard for cross-sectional imaging of retinal microstructures and is indispensable for the diagnosis and monitoring of macular diseases [5]. Conventional tabletop OCT systems, however, are expensive, require dedicated infrastructure, a stable power supply, and trained personnel, and are generally concentrated in urban tertiary centres [6]. Consequently, large segments of the rural population remain dependent on basic eye examinations or outreach camps that lack advanced imaging capability.

Portable OCT technology has emerged as a promising solution for extending retinal imaging beyond conventional hospital settings. Recent studies have demonstrated that portable and handheld OCT systems can provide clinically useful images while enabling screening in community clinics, mobile units, and resource-limited environments [7]–[9]. Such devices are particularly relevant in countries like India, where geographic barriers, travel costs, and limited availability of specialists contribute to delayed ophthalmic care.

The deployment of indigenous portable OCT systems may

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offer additional advantages, including lower operational costs, easier maintenance, and scalability for large-scale public health programs. Integration of portable retinal imaging with teleophthalmology and artificial intelligence-based screening has been proposed as a future strategy for addressing disparities in eye care access [10]–[12].

To explore the practical applicability of portable OCT in a rural setting, a two-day eye-screening camp was organised at the Sringeri Eye Camp in Sringeri, Karnataka, India, in collaboration with MedevPlus. During this program, 135 eyes were screened using the IXanner® 7Vn portable OCT device. The initiative aimed not only to identify retinal abnormalities but also to assess the operational feasibility of deploying advanced retinal imaging technology in a community environment where the nearest conventional OCT facility was located more than 80 km away for many participants. The camp screened 135 eyes over two days using a portable OCT device in a setting where many participants lived more than 80 km from the nearest conventional OCT facility.

The present study reports the clinical utility, field feasibility, and public health implications of portable OCT deployment during this rural outreach program.

2. Materials and Methods

A. Study Design and Setting

This was a cross-sectional observational screening study conducted during a community eye screening camp held on 31 July and 1 August 2025 at an eye camp in Sringeri, Karnataka, India. The screening program was organised to improve access to retinal imaging for patients residing in surrounding rural and semi-urban communities where advanced ophthalmic imaging facilities are limited. Comprehensive ophthalmic evaluation was performed as part of the routine clinical workflow, and participants requiring retinal assessment underwent Optical Coherence Tomography (OCT) imaging using the IXanner® 7Vn portable Spectral-Domain Optical Coherence Tomography (SD-OCT) system.

B. Participants

A total of 67 participants attended the community eye screening program and underwent ophthalmic evaluation. Retinal imaging was performed using the IXanner® 7Vn portable Spectral-Domain Optical Coherence Tomography (SD-OCT) system, resulting in OCT acquisition from 135 eyes during the two-day screening camp. The screening primarily targeted individuals at risk of retinal pathology, including elderly participants and those with systemic conditions such as diabetes mellitus.

C. Ophthalmic Examination

All participants underwent a routine ophthalmic evaluation that included recording of relevant ocular and systemic history, visual acuity assessment, and anterior and posterior segment evaluation using an indirect ophthalmoscope (IDO). Subsequently, retinal imaging was performed in all participants using the IXanner® 7Vn portable Spectral-Domain Optical Coherence Tomography (SD-OCT) system. OCT findings were

interpreted by qualified ophthalmologists in conjunction with the clinical examination.

D. Device Description

The IXanner® 7Vn (MedevPlus Pvt. Ltd., Bengaluru, India) is an indigenous, portable Spectral-Domain Optical Coherence Tomography (SD-OCT) system developed for retinal imaging in outpatient departments (OPD), pediatric ophthalmic imaging, and community-based eye screening programs. The device has been specifically designed to facilitate high-quality retinal imaging in resource-limited settings where conventional tabletop OCT systems may be unavailable or impractical.

Unlike conventional stationary OCT platforms, the IXanner® 7Vn is a lightweight, battery-operated, field-deployable imaging system that can be transported and operated with minimal infrastructure requirements. The device enables retinal imaging in outpatient clinics, rural health centres, community eye screening camps, mobile eye care units, and bedside examinations. Its compact design allows imaging to be performed in environments without a dedicated imaging suite while maintaining clinically acceptable image quality.

The imaging system is based on Spectral-Domain Optical Coherence Tomography (SD-OCT) technology and utilises a broadband Superluminescent Diode (SLD) light source with a centre wavelength of approximately 840 nm. The system provides an axial resolution of approximately 4.3 μm in tissue and a transverse resolution of approximately 15 μm , with an imaging depth of 2.7 mm. Image acquisition is performed at scan speeds of up to 40,000 A-scans per second, enabling rapid acquisition of high-resolution cross-sectional retinal images. The optical design supports imaging through pupils as small as 2.5 mm, thereby reducing the need for pharmacological pupil dilation in routine screening.

The current screening configuration of the IXanner® 7Vn includes macular imaging protocols optimised for handheld retinal imaging. Available acquisition protocols include a Single-Point High-Definition Raster Scan (512×30 B-scans) with start-stop image capture and a Quick 3D Volume Scan (512×128 B-scans) for volumetric assessment of the macula.

The software provides high-resolution retinal cross-sectional images, along with retinal layer enhancement, to facilitate visualisation of retinal architecture. The present version does not incorporate automated retinal thickness measurements, retinal nerve fibre layer (RNFL) analysis, ganglion cell complex (GCC) analysis, optic nerve head (ONH) analysis, or artificial intelligence-based diagnostic algorithms.

The system operates through a dedicated laptop interface with the IXanner® 7Vn Software, which provides image acquisition, real-time visualisation, image review, report generation, and secure data storage. The software enables clinicians to review OCT images immediately after acquisition, facilitating rapid clinical decision-making during community screening programs. The device can operate without a dedicated dark room, continuous internet connectivity, or an external power supply, making it suitable for deployment in outreach settings.



Fig. 1. IXanner® 7Vn portable Spectral-Domain Optical Coherence Tomography (SD-OCT) system developed by MedevPlus

E. Intended Use

The IXanner® 7Vn used in the present study is the screening version of the platform and is intended to assist trained eye care professionals in acquiring high-quality retinal OCT images to support the early identification of structural retinal abnormalities that may require comprehensive ophthalmic evaluation. The device is designed as a clinical imaging and screening tool to support referral decisions rather than to establish a definitive diagnosis.

The IXanner® 7Vn is not intended to function as an autonomous diagnostic device and does not provide automated clinical diagnoses or treatment recommendations. Interpretation of OCT images was performed by qualified ophthalmologists in conjunction with comprehensive clinical examination, medical history, and other ophthalmic investigations where appropriate.

Accordingly, the IXanner® 7Vn should be regarded as a clinical decision-support imaging system intended to facilitate early detection, screening, and referral of retinal diseases, particularly in underserved and resource-constrained settings.

F. Imaging Protocol

Macular scans were acquired for the detection of:

- Diabetic maculopathy

- Age-related macular degeneration
- Macular edema
- Vitreomacular traction
- Other clinically relevant retinal pathologies

The average scan acquisition time was 30–40 seconds per eye. Imaging was generally performed without pharmacologic dilation; however, dilation was considered when media opacity significantly affected image quality.

G. Clinical Review

OCT images were reviewed on-site by ophthalmologists from Sringeri, Karnataka, India. Immediate clinical discussion, referral planning, and follow-up recommendations were made when abnormalities were identified.

H. Outcome Measures

The primary outcomes were:

- Feasibility of portable OCT deployment in a rural setting.
- Successful acquisition of interpretable OCT images.
- Identification of clinically significant retinal abnormalities.
- Operational performance under field conditions.

3. Results

A. Key Findings

1) Real-time review

- A total of 67 participants, 135 eyes were successfully scanned during the two-day outreach program. 13 eyes demonstrated retinal changes suggestive of early to advanced retinal pathology.
- The IXanner® 7Vn portable OCT functioned reliably in the rural hospital environment.
- On-site ophthalmologist review enabled immediate clinical discussion and referral planning.
- Early signs of diabetic maculopathy, macular degeneration, and other retinal abnormalities were

Table 1
Technical specifications

Parameter	Specification
Device	IXanner® 7Vn
Manufacturer	Medevplus Pvt. Ltd., Bengaluru, India
Imaging Technology	Spectral-Domain Optical Coherence Tomography (SD-OCT)
Intended Use	Retinal screening and clinical decision support
Device Type	Portable, battery-operated OCT
Light Source	Broadband Superluminescent Diode (SLD)
Center Wavelength	840 nm
Axial Resolution	4.3 μm (tissue)
Transverse Resolution	15 μm
Imaging Depth	2.7 mm
Scan Speed	Up to 40,000 A-scans/s
Minimum Pupil Diameter	2.5 mm
Scan Protocols	Single-Point HD Raster (512 $\times$ 30), Quick 3D Volume (512 $\times$ 128)
Image Enhancement	Retinal layer enhancement
Automated Analysis	Not available in the current screening version
Display Interface	Laptop-based IXanner® 7VN Software
Power Source	Rechargeable battery
Dark Room Requirement	Not required
Internet Requirement	Not required
Typical Scan Time	30–40 s per eye
Intended Users	Ophthalmologists, Optometrists, and trained eye care professionals

identified in a significant proportion of screened individuals.

- For many participants or patients who underwent a scan, the nearest conventional OCT facility was located more than 80 km away.

Table 2
Operational performance of portable OCT

Parameter	Observation
Total eyes scanned	135
Average scan time	30–40 seconds/eye
Need for a dark room	No
External power requirement	No
Internet requirement	No
Field portability	Demonstrated successfully
On-site image review	Yes

B. Distribution of Operational Characteristics

Table 3
Clinical and accessibility observations

Domain	Observation
Diabetic maculopathy	Early to advanced signs identified
Macular degeneration	Early to advanced signs identified
Other retinal abnormalities	Detected during screening
Nearest OCT facility	80 km for many participants
Immediate referral planning	Enabled by on-site review

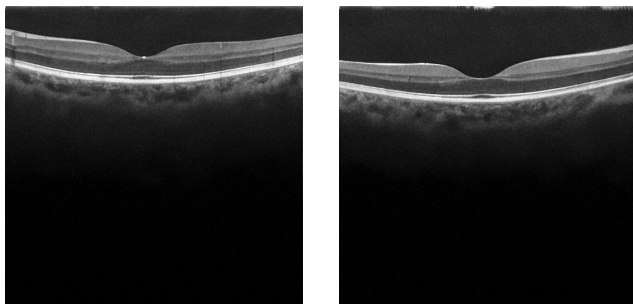


Fig. 2. Representative normal macular OCT scan acquired using the IXanner® 7Vn portable SD-OCT

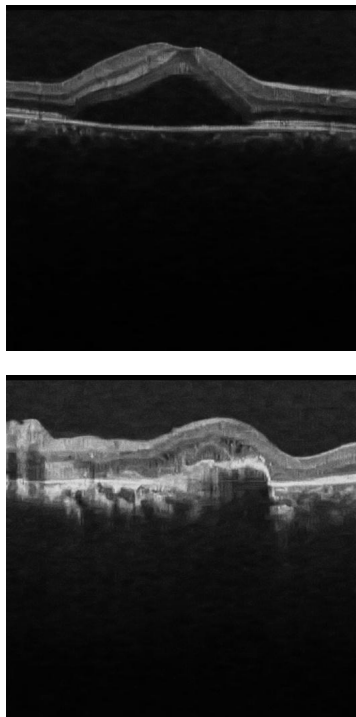


Fig. 3. Representative retinal abnormalities identified during community screening using the IXanner® 7Vn

C. Feasibility Confirmed

The screening program demonstrated that high-quality retinal imaging could be performed in a rural setting using a portable OCT platform without dependence on conventional ophthalmic infrastructure. Real-time image review facilitated immediate clinical decision-making and reduced the need for delayed referrals.

4. Discussion

This study demonstrates the practical feasibility of deploying an IXanner® 7Vn portable spectral-domain OCT device for community-based retinal screening in a rural Indian setting. Over a two-day outreach program, 135 eyes were successfully imaged without the need for a dedicated dark room, external power source, or internet connectivity. The findings highlight the potential role of portable OCT technology in addressing a major barrier to retinal care for underserved populations: access to advanced diagnostic imaging.

The burden of retinal disease is increasing worldwide, particularly because of the rising prevalence of diabetes and age-related ocular disorders. India is estimated to have one of the largest populations of individuals with diabetes, and diabetic retinopathy has become a significant cause of preventable vision loss [13], [14]. Early identification of diabetic maculopathy is crucial because treatment outcomes are generally better when intervention occurs before irreversible structural damage develops [15]. Conventional OCT has transformed the diagnosis and management of diabetic macular oedema and other macular pathologies; however, its availability remains concentrated in tertiary centres [16].

A key observation from the present study was that many participants resided more than 80 km from the nearest conventional OCT facility. Geographic distance is a well-recognised determinant of delayed ophthalmic care in rural populations [17]. Travel expenses, loss of daily wages, and the need for accompanying family members frequently discourage patients from seeking specialised retinal evaluation [18]. By bringing OCT imaging directly to the community, the screening program reduced these barriers and enabled earlier identification of potentially sight-threatening conditions.

The operational performance of the IXanner® 7Vn portable OCT was notable. Average acquisition time of 30–40 seconds per eye compares favourably with community screening workflows reported for other portable imaging systems [19].

The ability to function without external infrastructure is particularly important for outreach camps conducted in resource-constrained settings. Previous studies evaluating handheld and portable OCT devices have similarly emphasised portability, rapid acquisition, and reduced infrastructure requirements as major advantages for community deployment [20], [21].

Another important aspect was the integration of on-site ophthalmologist review. Real-time interpretation allowed immediate clinical discussion and referral planning, potentially reducing delays between screening and specialist evaluation. Teleophthalmology programs have demonstrated that rapid image review can improve referral efficiency and enhance continuity of care [22]. Although the present study relied on direct on-site review rather than remote interpretation, the workflow establishes a foundation for future integration with teleophthalmology platforms.

The screening identified early signs of diabetic maculopathy, macular degeneration, and other retinal abnormalities in a significant proportion of participants. While the study was not designed to determine disease prevalence, these findings reinforce the value of OCT as a screening adjunct for populations at risk of retinal disease. Several community-based retinal screening studies have shown that OCT can detect subclinical macular pathology that may not be apparent on routine examination alone [23], [24]. Early detection may facilitate timely referral and treatment, thereby reducing the risk of irreversible visual impairment.

The study also has broader public health implications. India has made substantial progress in cataract services, yet retinal diseases are emerging as increasingly important contributors to visual disability [25]. An important aspect of the present study was the deployment of the IXanner® 7Vn screening configuration, which is intended to serve as a retinal imaging and clinical decision-support system rather than a standalone diagnostic platform. The device was designed to acquire high-quality retinal OCT images, which are subsequently interpreted by qualified ophthalmologists alongside the patient's clinical history and comprehensive ophthalmic examination. Consequently, the IXanner® 7Vn does not independently diagnose retinal diseases or replace clinical judgement. This workflow closely reflects real-world community screening practice, where advanced imaging is used to facilitate the early identification of individuals who require specialist evaluation and timely referral, rather than to establish definitive diagnoses. Such an approach is consistent with current recommendations for community retinal screening, where imaging technologies serve as adjunctive tools to improve the detection of retinal pathology and optimise referral pathways.

The successful deployment of the IXanner® 7Vn in a rural outreach setting demonstrates the potential of indigenous portable OCT technology to improve access to retinal imaging in underserved populations. Community screening models that combine portability, affordability, rapid image acquisition, and minimal infrastructure requirements may help extend retinal diagnostic services to regions where permanent OCT facilities are either unavailable or economically unfeasible. Furthermore,

the collaborative framework involving a medical device manufacturer, a non-governmental organization, and tertiary ophthalmic care providers represents a practical and scalable model for expanding advanced retinal screening services within community eye care programs.

Future developments of the IXanner® 7Vn platform may further enhance its clinical utility. Integration with multimodal retinal imaging, including fundus photography, would provide complementary structural information and facilitate more comprehensive retinal assessment [26,27]. Additionally, incorporation of artificial intelligence (AI)-based image analysis could support automated image quality assessment, referral prioritisation, and risk stratification in large-scale screening programs [28]. Recent studies have demonstrated that AI-assisted retinal screening algorithms achieve high sensitivity and specificity in detecting diabetic retinopathy and other retinal disorders, suggesting that integrating portable OCT with AI-enabled decision-support systems may substantially improve screening efficiency, particularly in resource-constrained settings with limited access to retinal specialists.

The present study has several limitations. First, the screening program was conducted at a single rural centre over two days with a relatively modest sample size, limiting the generalisability of the findings. Second, detailed participant-level demographic information, disease classification, and longitudinal follow-up data were unavailable through the outreach program, precluding assessment of disease prevalence and clinical outcomes. Third, the current screening version of the IXanner® 7Vn was designed primarily for retinal image acquisition and referral support and does not incorporate automated diagnostic algorithms, retinal thickness quantification, retinal nerve fibre layer (RNFL) analysis, ganglion cell complex (GCC) analysis, or optic nerve head (ONH) assessment. Finally, the study did not include a direct comparison of image quality or diagnostic agreement with conventional tabletop SD-OCT systems. Future multicentre studies involving larger cohorts and comparative validation against established commercial OCT platforms are warranted to further evaluate the clinical performance, diagnostic agreement, and potential role of the IXanner® 7Vn in routine ophthalmic practice.

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