

## PRESS RELEASE

### Smartphones as Retinal Cameras: New Opportunities for Global Eye Care

International review led by Bonn-based researchers assesses the potential and limitations of smartphone-based retinal imaging

**BONN, September 30 – Smartphones could play an important role in the early detection of eye diseases, including in settings where specialized ophthalmic infrastructure is limited. An international team of experts led by the University Hospital Bonn (UKB) and the University of Bonn has comprehensively reviewed the current global landscape of smartphone-based fundus imaging. The researchers highlight the technical and clinical possibilities that already exist today, identify the limitations of these methods, and outline the conditions that must be met so that smartphone-based retinal imaging can be more widely integrated into screening, triage, and telemedicine pathways. The review article is now published in the journal *Progress in Retinal and Eye Research*, one of the most internationally renowned ophthalmology journals, where such contributions are published by invitation only.**

Smartphones are widely used around the world. For retinal imaging, their built-in cameras can be combined with special optical adapters and lighting systems. This results in compact and mobile solutions that may be of particular interest for telemedicine applications and for regions with limited access to ophthalmological care. Under Bonn's leadership, an international team of authors from Germany, the United Kingdom, Brazil, India, and the United States analyzed 30 technical solutions as well as 274 scientific publications and other relevant sources. In addition to the technical development of the various systems, the review assessed their clinical applications, image quality, and diagnostic performance, as well as telemedicine, artificial intelligence (AI), the involvement of non-physician healthcare professionals, regulatory requirements, data protection, and implementation in different healthcare systems.

#### Analysis shows potential for screening and triage

Some smartphone-based systems already achieve image quality and a field of view that can support screening or triage in selected application scenarios. The evidence to date is particularly relevant for diabetic retinopathy, for glaucoma-associated changes in the optic disc, and for selected applications in retinopathy of prematurity. "Smartphone-based retinal imaging has moved well beyond the stage of a technical experiment. Our analysis shows that it can already support selected screening and triage scenarios. At the same time, we wanted to clearly highlight where the evidence is robust and where important questions remain

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unanswered,” says Dr. Maximilian Wintergerst from the UKB Eye Clinic, who also conducts research at the University of Bonn.

### **Bringing eye exams closer to people**

In settings where ophthalmic infrastructure and specialist personnel are limited, establishing comprehensive screening programs can be challenging because of infrastructure requirements and costs. Smartphone-based imaging could serve as a building block within new, decentralized care models. According to the analysis, other trained healthcare professionals can also capture usable retinal images after receiving appropriate training. The images can then be transmitted via telemedicine to specialized centers for evaluation. Such an approach can be particularly important for conditions that require regular screening of large population groups. These include, for example, diabetic retinopathy. “The smartphone does not replace an ophthalmological examination. Rather, it can help expand access to retinal imaging, identify affected individuals with abnormal findings at an early stage, and refer them more effectively to specialized diagnostic and treatment services,” says lead author Raphael Lechtenboehmer from Wintergerst’s research group, which is also active in this field and has developed and tested approaches using smartphone-based fundus photography in several international projects.

### **Artificial intelligence could further transform mobile imaging**

The combination of smartphone-based retinal imaging and AI could play an important role in the future. For example, AI systems could assess, even as the image is being captured, whether the image quality is sufficient and whether the required area of the retina has been fully captured. In addition, automated selection of suitable individual images from image sequences, the merging of multiple images, and computer-aided detection of pathological changes are all conceivable. “Particularly in screening programs with large numbers of patients, such automated support could help ensure that limited personnel resources are deployed more effectively,” says Wintergerst.

### **International collaboration led by Bonn**

To bring together global expertise for this work, the Bonn team assembled experts from various regions of the world. “This work exemplifies how important international scientific collaboration is for addressing global challenges in ophthalmology. Close collaboration with leading partners worldwide is particularly important to us. The fact that an international team of experts under Bonn’s leadership is comprehensively mapping such a dynamic and clinically relevant field underscores the international networking and scientific visibility of our institution,” says Prof. Frank G. Holz, Director of the Eye Clinic at the UKB and a member of the Cluster of Excellence ImmunoSensation<sup>3</sup> at the University of Bonn.

### **Uniform standards and large-scale implementation studies are still lacking**

However, the analysis also makes it clear that significant questions still need to be resolved before widespread use can occur. These include differences between the various smartphone-based imaging systems in terms of image quality and field of view, as well as their compatibility with different smartphone models. Added to this are requirements regarding regulatory approval, light and device safety, data protection, and cybersecurity.

“Furthermore, there has not yet been sufficient research into the conditions under which smartphone-based screening programs can be operated economically and sustainably in the long term, and whether they ultimately lead to improved care and better treatment outcomes,” says Wintergerst. The authors therefore call for larger-scale implementation and cost-effectiveness studies, as well as minimum reporting standards for future studies. They view their work not only as an assessment of the available technology but also as a guide for clinicians, researchers, and decision-makers who are evaluating where smartphone-based retinal imaging can be meaningfully integrated into screening, telemedicine, and referral systems.

**Publication:** Lechtenboehmer R et al.: Smartphone-based fundus imaging in global eye care: Closing the gap; *Progress in Retinal and Eye Research*; DOI: <https://doi.org/10.1016/j.preteyeres.2026.101515>

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**Image:**



**Caption: Smartphone-based retinal imaging in clinical practice in India:** The image was taken during a collaborative project between University Hospital Bonn (UKB) and Sankara Eye Foundation India on smartphone-based telemedical screening for diabetic retinopathy. Mobile retinal imaging may help extend access to screening in settings where conventional fundus cameras or specialist eye care are not readily available.

**Image credit:** University Hospital Bonn (UKB) and Sankara Eye Foundation India

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**About the University Hospital Bonn:** As one of Germany's leading university hospitals, Bonn University Hospital (UKB) combines excellence in medical care and research with high-quality teaching. Every year, UKB treats more than half a million outpatients and inpatients. Around 3,500 students are enrolled in medicine and dentistry, and over 600 individuals receive training in healthcare professions annually. With around 9,900 employees, UKB is the third-largest employer in the Bonn/Rhein-Sieg region. In the „*Focus* hospital rankings“, UKB is rated the top university hospital in North Rhine-Westphalia and has the second-highest case mix index (an indicator of treatment complexity) of all university hospitals nationwide. In 2025, UKB secured nearly €100 million in third-party funding for research, transfer, and teaching. For the fourth consecutive year, the F.A.Z. Institute recognized UKB as both “Germany's Training Champion” and “Germany's Most Desirable Employer.” For current figures and further information, please refer to the annual report at: [geschaeftsbericht.ukbonn.de](https://www.ukbonn.de/geschaeftsbericht)