

## Commentary: Dawn of smartphones in frugal ophthalmic innovation

We are living in an era of accelerated innovations. Tinkerers, makers, and other hardware hobbyists now find it easier not only to obtain information to learn and make new things but also to get the materials required from a multitude of online shops and share the knowledge with online communities. Ophthalmology is one branch of medical science where technology is rapidly evolving.

Several innovations are technologically advanced and clinically amazing, but many are too expensive for mainstream use. The innovations of most interest to the common ophthalmologist, however, are those simple, economical, genius ideas – the frugal innovations.<sup>[1]</sup> In low-resource medical settings,<sup>[2]</sup> these frugal and reverse innovations are inexpensive and effective alternatives<sup>[3]</sup> to the existing expensive technology. Several attempts have been made at low-cost smartphone fundus photography, including some like DIYretCAM,<sup>[4]</sup> which have been open-sourced and some which use three-dimensional printed parts.<sup>[5]</sup>

Low-cost fundus imaging techniques have used things starting from digital cameras attached to slit lamp to video camera indirect ophthalmoscopy to nasal endoscope to finally smartphones.<sup>[6]</sup> The accompanying article<sup>[7]</sup> shows yet another method of fundus photography that can be done by a common ophthalmologist with a 90D lens readily available with them. They also demonstrate the technique of fundus photography with a direct ophthalmoscope. It is of particular interest to young ophthalmologists and postgraduate students when they find a patient with an interesting fundus finding. Previously, they had no easy way to show the findings to a colleague or senior and get their expert opinion unless they were nearby and not busy. With these low-cost methods of fundus photography, they can post interesting fundus photographs on a group (with due caution)<sup>[8]</sup> and get expert opinion and discussion from around the world.

Commercial portable fundus cameras are expensive and even where available, fear of damaging the camera restricts its use. Almost all ophthalmologists nowadays carry smartphones with decent quality cameras, and they are required to have their own direct ophthalmoscope, 90D and often 20D lens from the beginning of their postgraduation program. These techniques of smartphone fundus photography make it possible for all interested ophthalmologists to have their personal fundus camera ready at a minute's notice.

This will help in a better learning experience, easier teaching experience, safer patient care, and fuller understanding by the patients of their illness.

With every passing year, the role of smartphones in ophthalmology<sup>[9]</sup> is bound to increase, with many more

possibilities opening up as apps are made for vision testing, electronic medical records, and much more.

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