The Optic Nerve Head; a review of the normal variants, disc anomalies and optic nerve disorders that may be encountered during retinal screening clinics

Authors: Dr Helena Hurairah, Mr Fion Bremner from University College London Hospital NHS Foundation Trust

Article aims:

To recognise the clinical signs and symptoms of optic nerve dysfunction, to describe the features of a normal optic disc, to perform a basic assessment of an optic nerve head photograph, to be aware of normal variants of the optic disc that may be encountered during retinal screening, to identify optic nerve head abnormalities that may warrant referral to ophthalmic services.

Introduction

The optic nerve, cranial nerve II, relays electrical information from the photoreceptors in the retina to the brain for visual interpretation. It is about 50mm long and made up of 1.2 million axons (nerve fibres). Both optic nerves run posteriorly from the visible optic disc eventually forming a structure called the optic chiasm. At the chiasm, the nasal optic nerve fibres cross over to the other side. Due to this anatomic arrangement, damage to the optic nerve or anywhere along the visual pathway gives rise to specific patterns of visual field loss. Embryologically and anatomically, the optic nerve is different from the other cranial nerves in the fact that it is more an outgrowth of the brain and stems from the forebrain (the majority of the other cranial nerves originate from the brainstem). It is ensheathed in all three meningeal layers (dura, arachnoid and pia mater) and has little regenerative ability. Thus, any insult to the optic nerve commonly results in irreversible visual loss.

The optic nerve, traditionally, is divided into four parts: intraocular (the visible optic nerve head or optic disc), intraorbital, intracanalicular and intracranial. The intraocular segment of the optic nerve itself can be subdivided into three parts; superficial nerve fibre layer, lamina choroidalis and lamina cribosa (the scleral portion).

For the purposes of this article, we shall be focusing on optic nerve head abnormalities that may be encountered by the screening staff during their assessment of retinal images.

Normal optic disc appearances

There are many normal variants of optic discs. When interpreting the optic disc appearance, any suspected abnormalities should correlate with the patient's history and demographics in addition to clinical findings. The following signs and symptoms give an indication of likely optic nerve abnormalities;

- Mild to severe central visual loss
- The presence of a relative afferent papillary defect
- Reduced colour vision
- Visual field defects.

The image illustrates the appearance of a normal, healthy optic nerve head. A normal optic disc is vertically oval shaped and ranges from pink to yellow-orange in colour. It has a distinctive, regular outline particularly temporally. The average diameter of the optic disc is 1500µm although this may vary according to the refractive status of the patient.

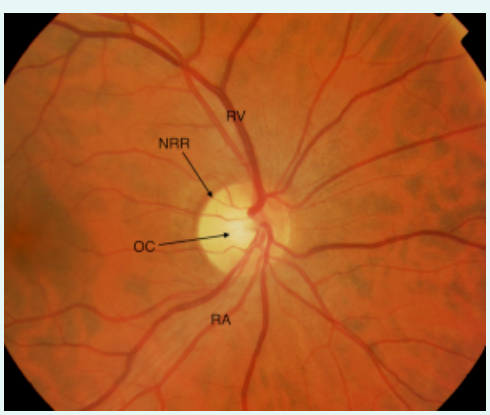


Figure 1. Photograph of a normal optic nerve head. Note the clearly defined neuroretinal rim (NRR) and central bright optic cup (OC)

The ‘cup’ in the centre of the optic disc represents the part of the intraocular segment of the nerve in which axons are absent. This can be especially prominent in glaucomatous optic nerves, which shall be discussed in further detail shortly. The central retinal artery and central retinal vein enter the eye within the optic disc. Retinal arteries are viewed as lighter, thinner blood vessels whereas retinal veins appear thicker in calibre and are darker in colour.

Assessment of the optic nerve head

There are numerous ways in which to interpret the optic disc. In the setting of retinal screening and without the advantage of being able to view the disc stereoscopically, a simple method to assess the optic nerve head is the ‘three Cs rule’; Colour, Contour and Cup.

Colour: As mentioned previously, the normal optic disc colour can vary between individuals. An orange pink appearance indicates a healthy well-perfused optic nerve head. Atrophy of the optic nerve causes the optic disc to appear pale, almost white, in colour. This is due to a reduction in the neuroretinal tissue volume and astrocytic proliferation.

Contour: The neuroretinal rim, viewed as the optic disc borders, is normally well defined. Loss of this definition may be due to causes such as inflammation or raised intracranial pressure. The presence of deposits of calcium in the optic nerve, a condition called optic disc drusen, can give rise to a lumpy looking optic disc that can easily be confused with optic nerve head swelling.

Focal thinning of the neuroretinal rim is commonly seen in glaucomatous optic neuropathy. The ISNT rule is of particular usefulness when evaluating whether the thinning is physiological or due to optic nerve disease. A normal healthy optic disc tends to have the thickest part of the neuroretinal rim inferiorly, then superiorly, followed by the nasal portion with the thinnest part being the temporal region.

Cupping: The optic cup has been discussed briefly. The vertical height of the pale central cup of the optic nerve head is compared to the overall vertical diameter of the optic disc to give a figure called the cup to disc ratio (CDR). A normal optic cup occupies about a third of the total optic nerve head i.e. a cup to disc ratio of 0.3

An increased CDR value indicates a reduction in healthy neuroretinal tissue and raises the suspicion of glaucomatous changes, commonly associated with a sustained rise in intraocular pressure.

Normal variants of the optic disc

The normal optic nerve head size appearance varies between individuals. To be able to differentiate between a normal optic disc and a pathological disc, it is important to be aware of the range of normal optic discs that may typically be encountered during retinal screening.

Several factors should be considered when viewing a suspicious looking optic disc such as the patient’s age, race and refractive status in addition to clinical complaints and findings. Highly myopic patients generally have larger optic discs than normal. In contrast, the optic nerve head size tends to be smaller in patients with a hypermetropic refractive error. The smaller than average size of the hypermetropic optic disc gives rise to an elevated and crowded appearance at the optic nerve head.

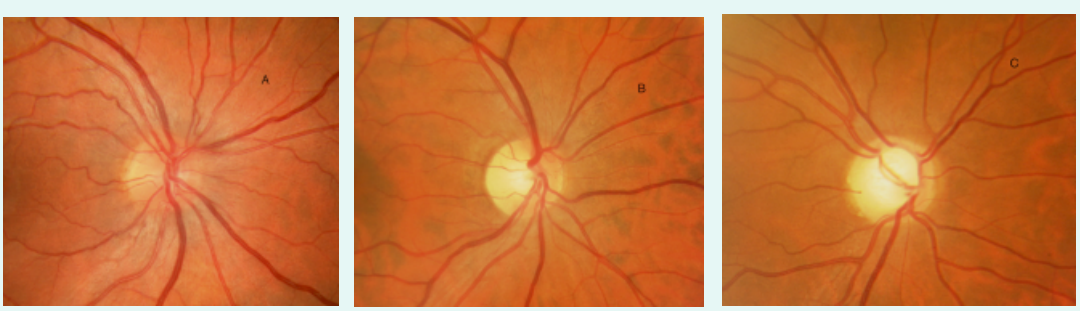


Figure 2. Optic disc photographs demonstrating **(A)** Small, crowded, hypermetropic optic disc lacking the appearance of a physiological cup **(B)** Normal optic disc **(C)** Physiological cupping in a large optic disc.

Anomalous optic discs and developmental malformations

Degenerative myopia

Pathological myopia can be seen in highly myopic eyes (>-6D) and a larger axial globe length (> 26mm). Progressive anteroposterior elongation of the globe gives rise to characteristic secondary changes that affect the retina, sclera, choroid and optic nerve.

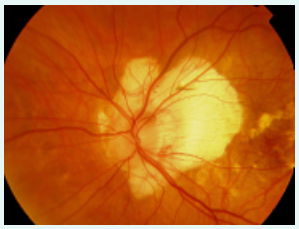


Figure 3. Degenerative myopia. The retina has a pale tigroid appearance and there is a large optic disc crescent. Focal chorioretinal atrophy is characterised by the visibility of underlying choroidal vessels and eventually the sclera.

Tilted disc

Oblique entry of the optic nerve into the globe results in an apparent tilting of the optic disc, usually inferiorly with the superior pole of the disc elevated when viewed stereoscopically. Blood vessels emerge from the optic nerve head temporally rather than nasally (situs inversus arteriosus). Tilted optic discs are common, usually bilateral and are associated with myopic astigmatism.

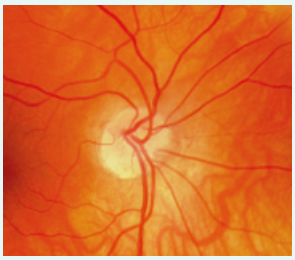


Figure 4. Photograph showing a small right tilted optic disc. The optic nerve head appears to have an oblique orientation.

Optic disc pit

An optic disc pit is viewed as a gray-white depression in the optic nerve head and is generally located inferotemporally. Visual acuity is usually normal. Associated complications include serous macular detachment.

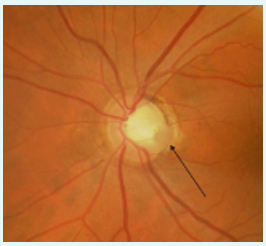
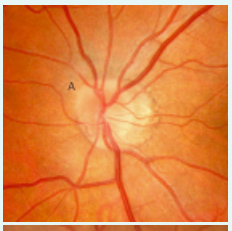


Figure 5.
Optic disc pit in the inferotemporal portion of the left optic disc as indicated by the arrow.

Optic disc drusen

Optic disc drusen are calcified hyaline bodies found within the prelaminar portion of the optic nerve head. They can be superficial or buried deep beneath the surface of the disc. They are present in about 0.3% of the population and are usually bilateral. On assessing the optic disc contours, the margins appear to be irregular and nodular in appearance and can easily be confused with optic disc swelling (pseudopapilloedema). Patients may have visual field defects, particularly with deeply buried drusen. Optic disc drusen are associated with several ophthalmic conditions such as retinitis pigmentosa and angioid streaks.



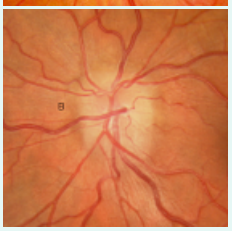


Figure 6.
(A) Buried right optic disc drusen

(B) Exposed right optic disc drusen showing an elevated disc and scalloped margins. Despite the disc elevation, the retinal blood vessels are not obscured. Also note the increased tortuosity of the major vessels.

Myelinated nerve fibres

In normal eyes, myelination usually ceases at the lamina cribosa. However, some retinal nerve fibres may retain a myelin sheath during the first month of life. This is seen as superficial white feathery streaks running within the nerve fibre layer towards the optic disc. Ocular associations include high myopia, anisometropia and amblyopia. It is usually unilateral.

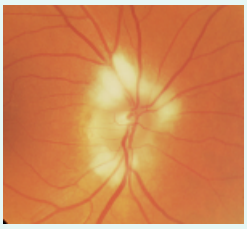


Figure 7.
Peripapillary nerve fibre myelination obscuring the borders of the right optic disc.

Optic disc swelling

Irrespective of the disease aetiology, optic disc swelling is caused by a gradual slowing down and consequent complete stasis of fast and slow axoplasmic flow at the levels of lamina choroidalis or lamina scleralis. This results in distension of the axon, which is then viewed ophthalmoscopically as optic disc swelling.

Clinical features of early or acute optic disc swelling include elevated hyperaemic optic nerve head, blurred disc margins, loss of the physiological cup, peripapillary nerve fibre layer oedema and flame shaped haemorrhages, chorioretinal folds, dilated tortuous veins, exudates and cotton wool spots (nerve fibre layer infarcts).

Optic disc swelling can be due to 1) inflammation, 2) ischaemia 3) raised intracranial pressure (papilloedema) or 4) optic nerve compression e.g. tumour.

Inflammatory optic disc swelling (optic neuritis)

Optic neuritis is defined as a subacute inflammatory process affecting the optic nerve. There are several causes of optic neuritis, the most common one being demyelination. This is a pathological condition whereby the normally myelinated nerve fibres lose their insulating layer of myelin. In the majority of cases, optic neuritis occurs as an isolated event. However, it is strongly associated with multiple sclerosis; the overall 10-year risk of developing multiple sclerosis after an attack of optic neuritis is 38%. Optic neuritis is mainly a disorder of the younger population, the majority of patients presenting between 20 and 50 years (mean age of 32 years). It is more common in female Caucasians and the incidence of optic neuritis tends to be higher in the spring months.

Other causes of optic neuritis can be **parainfectious** (following a fever or viral illness), **infectious** e.g. cat-scratch disease, Lyme disease, syphilis, or **non-infectious** systemic conditions such as sarcoidosis or systemic lupus erythematous.

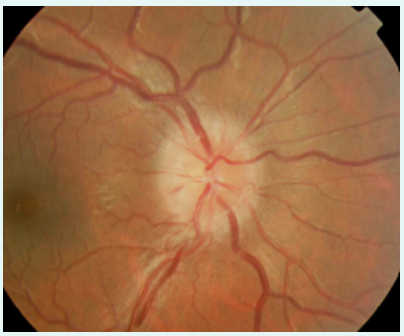
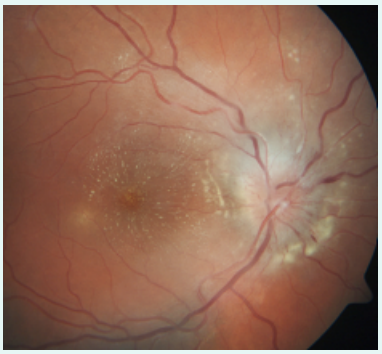


Figure 8.
Optic disc swelling in right optic neuritis.

Figure 9.
Acute neuroretinitis caused by Bartonella henselae (cat scratch disease) Neuroretinitis (formerly known as ODEMS; optic disc oedema and macular star) is characterized by papillitis associated with inflammation of the retinal nerve fibre layer and a macular star figure.



Ischaemic optic disc swelling

Anterior ischaemic optic neuropathy (AION) is a consequence of vascular insufficiency of the branches of the short posterior ciliary vessels that supply retrolaminar and laminar sections of the optic nerve head. There are two forms of AION; non-arteritic and arteritic, due to giant cell arteritis.

Non-arteritic ischaemic optic neuropathy (NAION) usually affects patients between 50 and 70 years. Typically, it presents painless acute loss of vision usually noticed upon awakening. The absence of pain may help differentiate ischaemic from inflammatory optic neuropathies. Patients usually have microvascular risk factors (diabetes, hypertension, smoking) and there is an association with collagen vascular disorders. Recurrence of NAION in the same eye is rare but there is a 40% risk of fellow eye involvement. Evidence suggests an anatomical predisposition for smaller optic discs with a low cup-to-disc ratio (‘disc at risk’).

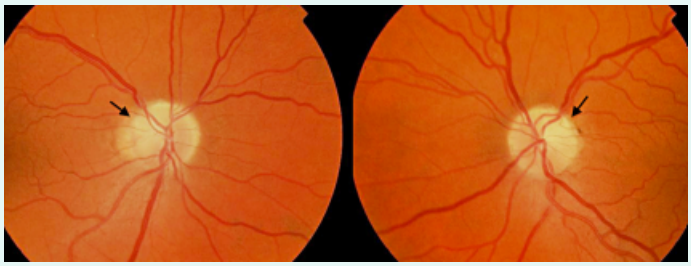


Figure 10.
Established bilateral non arteritic ischaemic optic neuropathy, showing sectoral temporal pallor.

Giant cell arteritis is an inflammatory vasculopathy that affects medium to large sized vessels. It usually affects females more than males over the age of 55 years. Patients usually complain of systemic symptoms such as anorexia, malaise, and proximal joint pain together with scalp tenderness, jaw pain and tenderness around the temporal arteries. In addition to arteritic ischaemic optic neuropathy, visual complications include diplopia, central retinal and branch artery occlusion, ciliary artery occlusion and rarely posterior ischaemic optic neuropathy.

Arteritic ischaemic optic neuropathy (AION) is an ophthalmological emergency and its visual consequences can be devastating if it is not recognised early and treated promptly with high dose corticosteroid treatment.

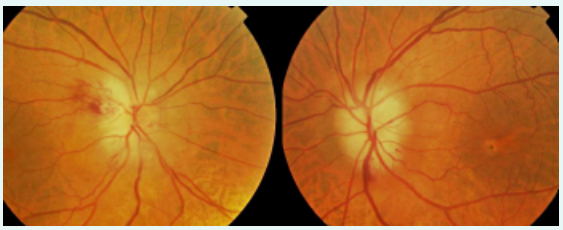


Figure 11.
Pallid disc oedema in arteric ischaemic optic neuropathy.

Papilloedema

Conventionally, the term papilloedema is used to describe optic disc swelling due to raised intracranial pressure. It is nearly always bilateral but may be asymmetrical. Patients may complain of early morning headaches, nausea and vomiting, pulsatile intracranial sounds and transient visual obscurations. Unless proven otherwise, any patient with papilloedema should be suspected of having an intracranial space-occupying lesion.

Idiopathic intracranial hypertension is a condition of female preponderance that affects mainly younger patients (mean age of 33 years). There is a strong association with a high body mass index. It is a diagnosis of exclusion whereby the brain MRI is normal and lumbar puncture reveals an elevated cerebrospinal fluid pressure with normal composition.

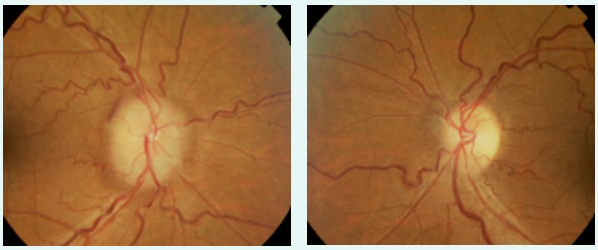


Figure 12. Asymmetric optic disc swelling in a patient with idiopathic intracranial hypertension. The hyperaemic right optic disc shows marked swelling in comparison to the left eye.

Glaucomatous optic neuropathy

Glaucoma is the most common optic neuropathy seen by ophthalmologists. It is a progressive, normally bilateral, optic neuropathy with characteristic optic disc appearances; large cup-to-disc ratio, vertical elongation of the optic cup, neuroretinal rim notching and the presence of disc splinter haemorrhages (not always). There is a typical pattern of nerve fibre bundle visual field loss that is mainly attributed to increased intraocular pressure (usually >21 mm Hg). Normal tension glaucoma occurs in patients who have normal intraocular pressure readings but progressive characteristic glaucomatous visual field pattern loss in the absence of any retrochiasmal pathology.

Glaucomatous optic neuropathy is a wide subspecialty and for the purposes of this article, we shall focus on glaucomatous optic disc appearances that may be encountered by the screener when evaluating retinal images. Differentiating between glaucomatous and non-glaucomatous cupping can be difficult and should not be based on optic disc appearance alone.

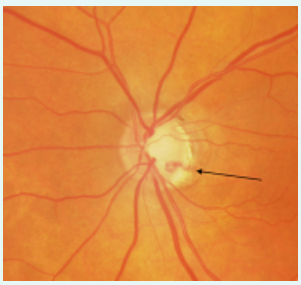


Figure 13. The arrow points towards an inferotemporal disc splinter haemorrhage in a glaucomatous cupped optic disc. Note the thinning of the temporal neuroretinal rim.

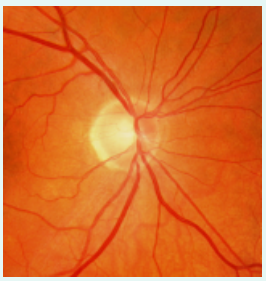


Figure 14. Right glaucomatous optic disc cupping. There is temporal rim thinning and a large optic disc cup. There is obliteration of the neuroretinal rim and the cuppin appears to extend to the margin of the optic disc. The inferior neuroretinal rim is thinner in comparison to the superior rim i.e. not obeying the ISNT rule.

Optic disc atrophy

Atrophic optic nerve heads are viewed as pallid 'chalky white' optic discs and are the final morphological endpoint of any prolonged optic nerve disease process that results in axonal loss and degeneration. Optic disc atrophy may be primary or secondary. Primary optic atrophy occurs without any preceding optic disc swelling and is normally due to lesions affecting the retrolaminar portion of the optic nerve such as retrobulbar neuritis, toxic and nutritional optic neuropathy or compressive causes e.g. tumours, aneurysms. Disc swelling precedes secondary optic disc atrophy. Causes include AION and chronic papilloedema.

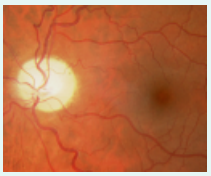


Figure 15.

Secondary left optic atrophy in a patient with previous anterior ischaemic optic neuropathy. The disc is bright white with poorly defined margins due to gliosis. There is reduction in the number of small vessels on the disc surface.

Diabetic papillopathy

This is a rare condition characterised by unilateral or bilateral optic disc swelling and disc surface telangiectasia in conjunction with a variable level of loss of vision in patients with either type 1 or type 2 diabetes. The pathophysiology of the condition is unclear but may be due to small vessel disease. Optic disc swelling is usually mild and vision spontaneously improves over a course of several months. The visual prognosis for diabetic papillopathy is usually good.

Conclusion

As discussed above, there are many normal variants of the optic nerve head and optic disc anomalies that may be encountered during routine diabetic retinopathy screening. However, in spite of their 'unusual' optic discs, these patients normally will have good vision (provided there is no other intraocular cause for reduced vision such as cataract or diabetic maculopathy).

Acquired optic nerve disorders typically present with an acute or subacute loss of central vision and these patients will initially seek the help of their primary care provider or attend eye casualty. They are rarely encountered in retinal screening clinics due to the speed of onset of their symptoms. In cases of optic nerve dysfunction, the diagnosis can never be made based purely on the optic disc appearance alone and all patients will require further investigations.

References

1. Maas E and Tomsak R. Diseases of the Optic Nerve. In: Farris BK ed. The Basics of Neuro-ophthalmology. Mosby, pp 241-275 **/ 2.** Morrison J. Anatomy and physiology of the Optic Nerve. In Kline LB ed. Optic Nerve Disorders. American Academy of Ophthalmology, pp 1-20 **/ 3.** Acheson JF, Optic nerve and chiasmal disease. In: Acheson J, Riordan-Eva P ed. Neuro-ophthalmology: Fundamentals of Clinical Ophthalmology. BMJ Books, pp 72-107 **/ 4.** Chiappe JP et al. Prevalence of disc cupping in non glaucomatous eyes. Medicina 2015; 75(1):6-10 **/ 5.** Kanski JJ. Developmental Malformations and Anomalies. In: Kanski JJ Clinical Ophthalmology; A Systematic Approach. Elsevier, pp 79-87 **/ 6.** Kanski JJ. Neuro-ophthalmology. In Kanski JJ Clinical Ophthalmology; A Systematic Approach. Elsevier, pp 786-799 **/ 7.** Biousse V. Ischemic Optic Neuropathies. In: Kidd DP et al Neuro-Ophthalmology (32); Blue Books of Neurology Butterworth Heinemann, pp 112-134

Special thanks to Chiara Contrino, ophthalmic photographer at the National Hospital for Neurology and Neurosurgery, for her assistance in obtaining the optic disc images.

Use of a portable fundus camera in setting up a diabetic retinopathy screening programme in Uganda

Mr Terry Cooper, B.Sc, D.Phil

Objective / Purpose:

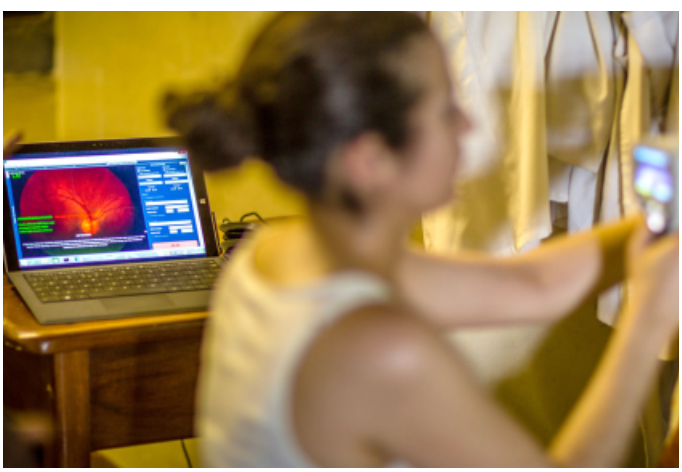
The objective of the study was to determine how effective a portable fundus camera would be in a diabetic retinopathy screening programme in Africa. The standard approach to fundus photography is to use a static bench top system where the patient is required to sit at the camera in order to be screened. Patients are also dilated in order to maximise the chances of obtaining a gradeable image. However, there are many patients who cannot be screened in this way. These include the house-bound, bed-ridden, obese and institutionalised. In developing countries, transport to medical centres may be difficult and a mobile camera may be useful in accessing these patients. Use of a portable non-mydriatic fundus camera avoids the need for dilating drops in many if not all patients.The study was carried out during a VISION2020 LINKS programme visit of a team from the Royal Free Hospital in London to the Mulago Referral Hospital in Kampala in April, 2015. The objective of part of this visit was to help establish diabetic retinal screening in Kampala as part of the Diabetic Retinopathy Network (DR-NET.comm) programme. There are 17 such programmes mostly in Africa and funded by The Queen Elizabeth Diamond Jubilee Trust.

Keywords:

diabetic retinopathy screening
portable fundus camera VISION2020 LINKS
programme avoidable blindness
Diabetic Retinopathy Network (DR-NET.comm)

Materials / Patients and Methods:

The study was carried out using the Pictor Plus portable fundus camera from Volk Optical linked to the Spectra Retineye diabetic screening software package from Health Intelligence. Pictor Plus is a lightweight, fully portable camera featuring a 5 megapixel image sensor, 40 degree field of view and nine internal fixation points and conforms to the ISO10940 image resolution requirement for fundus cameras. Spectra Retineye is a standalone software package that captures images from the fundus camera and allows their assessment with a choice of grading schemes including the one recommended by the UK National Diabetic Eye Screening Programme (NDESP). One objective of the study was to test the ability of the camera to operate without access to a reliable mains power supply. To this end, the camera was equipped with an adaptor cable that allowed it to be powered through a charging cradle from a solar-powered battery. During a two day period, 68 patients attending both a general and diabetic eye clinic were screened by either a specialist retinal nurse or an orthoptist. The images (both disc centred and macula centred for each eye) were transferred to the Spectra Retineye software package wirelessly over a local WiFi network and then assessed by an ophthalmologist.Those with abnormal retinal findings were also examined with optical coherence tomography (OCT) and treated with laser as appropriate.



Results and Conclusion:

None of the images would have complied with the UK NDESP standard in terms of image resolution and some would be considered un-gradebale. Nevertheless useful information was obtained on all patients and six patients were referred for laser treatment (2 proliferative and 4 maculopathy). The images were better if the patient had dilating drops before photography. The conclusion is that the camera has a useful place in the screening of diabetic retinopathy where it is not possible for the patient to have fundus photography using a static camera. Re-charging of the camera was improved by the use of a power surge protector or by using power directly from the solar-powered backpack. This capability will be of value to those screening and carrying out diagnostic tests in remote locations.

Submitted By: Mr Terry Cooper, B.Sc, D.Phil
Institution/University: Volk Optical Address1: 7893 Enterprise Drive City: MentorPostal Code: 44060

Notes on Uganda trip, April 2015

A VISION 2020 LINKS programme team lead by Chair of the International Committee of the Royal College of Ophthalmology, Clare Davey recently returned from Uganda where they helped to progress the diabetic retinopathy screening service at the Mulago Referral Hospital in Kampala. Members of the team based at the Royal Free Hospital were trainee ophthalmologists Tina Khanam and Robbie Walker as well as orthoptist Clémentine Casafina and retinal nurse, Sofia Mendonça. Terry Cooper of Volk Optical provided technical support including installation of the screening equipment. Consultant ophthalmologist, Geoffrey Woodruff joined the team to provide mentoring and training to the paediatric ophthalmology team at Mulago. Our main contacts in Mulago were ophthalmologists Moses Kasadhakawo and Grace Ssali.

The visit, which took place in April 2015, was carried out as part of a VISION 2020 LINKS programme between the Royal Free Hospital in London and the Mulago Referral Hospital in Kampala. Launched in 2004 by The International Centre for Eye Health in London, VISION 2020 LINKS programmes address an important need for human resource development for eye care in Africa. In such a link, an African eye department is matched with a UK eye department in a long term partnership with the objective of building capacity to deliver better quality care to their patients. The link between the Royal Free Hospital and Mulago has been in existence since 2010 and has seen five annual visits to Uganda by the Royal Free team as well as numerous reciprocal visits to the UK by Mulago staff.

The main objective of this visit was to help with the diabetic retinal screening in Kampala as part of the Diabetic Retinopathy Network (DR-NET.comm) programme. There are 17 such programmes mostly in Africa and funded by The Queen Elizabeth Diamond Jubilee Trust. An additional objective was to continue to build children's eye services in Kampala particularly in the area of childhood cataract.

Prior to the visit, the team had acquired a bench top fundus camera and OCT system as a result of generous charitable donations as well as significantly reduced pricing from the supplier, Topcon GB. Volk Optical also provided two portable fundus cameras for the duration of the visit equipped with Spectra Retineye Screening software donated by Health Intelligence. Rayner was also generous in providing a supply of viscoelastic and intra-ocular lenses.

On arrival in Kampala, the team was welcomed by Dr. Birabwa Male Doreen, Deputy Executive Director of the hospital and herself a paediatric surgeon. Dr. Birabwa Male thanked the team for their visit and for the equipment donations which she acknowledged as a major improvement in the capabilities of the eye clinic. She also commented that the team was visiting at an interesting time as the eye department is in the process of renovation and was temporarily located in an older building that was part of the X-ray department.

During a two day period, 68 patients attending both a general and diabetic eye clinic were screened by dilated fundus photography either by a specialist retinal nurse or an orthoptist. The images (both disc centred and macula centred for each eye) were transferred to the Spectra Retineye software package wirelessly over a local Wi-Fi network and then assessed by an ophthalmologist. Those with abnormal retinal findings were also examined with optical coherence tomography (OCT) and treated with laser as appropriate. One patient in particular, Mr. Charles Ndegeya from JInja benefitted from our visit. Fundus photography indicated significant maculopathy which was confirmed by the first OCT examination to be carried out in Uganda. Mr. Ndegeya was treated with laser the same day.

The paediatric team carried out 14 intra-ocular operations on children. Geoff Woodruff concentrated on training in the surgery of paediatric cataract, to allow better provision by the team there.

After the visit, team leader Clare Davey commented *"this visit was particularly successful because we had a very defined remit, because we have already established good working relationships with the team in Mulago, and because for the first time we had a member from the optical industry (Terry Cooper) who set up the equipment, optimized its use and helped train the local staff. I recommend similar Vision 2020 visits to concentrate on taking the most effective team"*

If you have any questions please contact the author: ***terry.cooper@volk.com***

Break Away from the Desktop

PICTOR PLUS

> High Resolution
> Non-Mydriatic
> Light Weight
> Portable

For more information on Pictor Plus please contact volk@volk.com or call +1.440.942.6161

Portable, powerful and practical — Volk Optical's Pictor Plus is the next generation in hand-held ophthalmic cameras.

Improved Patient Care

With Pictor Plus, your practice can join the revolution in innovative ophthalmic imaging for detection of retinal disease associated with diabetes, glaucoma, & AMD, as well as telemedicine.

Portable Practice

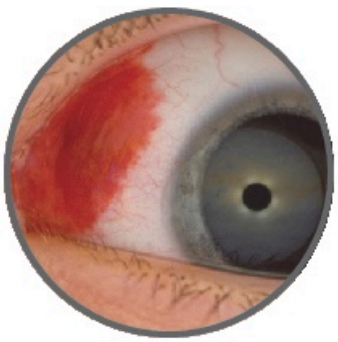
Weighing under a half kilo, Pictor Plus is easily portable & efficient in mobile situations beyond the exam room.

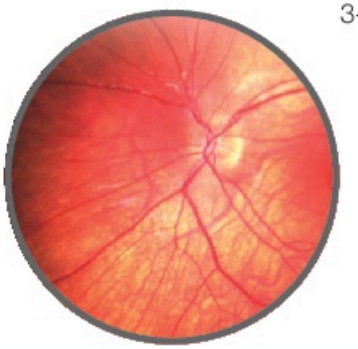
Simple Integration

Featuring Wi-Fi connectivity, Pictor Plus can seamlessly integrate with any PC, laptop, or mobile device to upload jpg images & patient information to your patient database system.

Superior Versatility

Two easily interchangeable imaging modules provide non-mydriatic retinal images, through as little as a 3-mm pupil, as well as anterior eye imaging.





VOLK® IMAGING

Twitter: @VolkOptical | **LinkedIN:** Volk Optical | **Facebook:** Volk Optical

Volk Optical Inc. | 7893 Enterprise Ave | Mentor, OH 44060 USA | P 800.345.1200 or 440.942.6161

SMS text reminder of patients appointments - analysis

Christopher Ingram, Team Leader & Senior Screener Grader from the Harrow Diabetic Eye Screening Programme

Introduction

In October 2014 the Harrow diabetic eye screening programme (DESP) had a programme size of just under 18,000 with an uptake of 82% at the end of Q2 2014-15. As Team Leader I was looking to implement processes that would increase KPI DE1 (uptake) but not increase the workload of programme staff. SMS messaging had been raised by a fellow programme within Medical Imaging UK (part of Emis Group) but no real developments had been made to make full use of this system. At the time SMS messaging was being done using our software provider (Digital Healthcare) in conjunction with NHS.net, which subsequently has now stopped providing the SMS system. With the SMS system under NHS.net costing us little to nothing it seemed like the most obvious option to tackle first. Within the programme as part of our referral failsafe systems we had been collecting mobile numbers from GPs and patients at each contact over the previous 14+ months. This meant that our mobile data was fairly good going into this process, which meant we stood a good chance of seeing positive results.

SMS system configuration within the Harrow DESP

The SMS system went live in the Harrow Diabetic Eye Screening Programme on the 9th October 2014. Below are the configuration settings we use for sending SMS text reminders.

Method of sending: OptoMize v4.0.2 via NHS.net

Dedicated NHS.net address: sms.harrowdesp@nhs.net

SMS reminder exclusion time: 1 Day

SMS reminder lead .... number of days: 3 Days

SMS reminder lead ..... time of day: 11.00 am

Raw SMS reminder text:

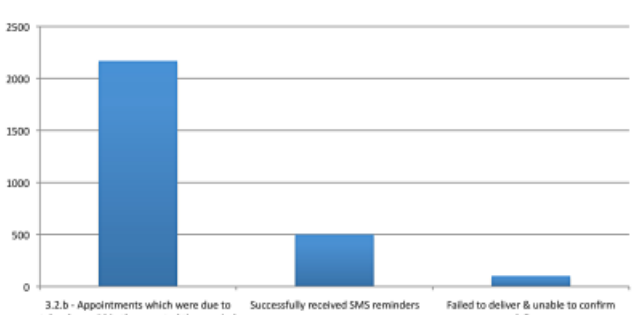
Please remember your Eye Screening appointment on ##AppointmentDate## Time:##AppointmentTime## at ##ClinicName##. If you can't attend please call 0208 795 6801

Currently all patients are opted into receiving SMS reminders with information on their appointment letter on how to opt out if they wish. Since auto opt in started we have sent over 3,500 appointments and not a single opt out request has been made by a patient. Mobile phone data has been collected either at point of referral into the DESP and/or at point of screening for the last 14+ months. Medical Imaging's in-house business intelligence manager has also developed a script that can be run from their custom reporting & data extraction tool to find all patients with a mobile number not in a mobile field preventing SMS reminders from sending.

On average the Harrow DESP runs 3 clinics a day with an average of 33 patients booked into each clinic meaning around 100 total patient appointments each day. Of these 100 patients around 25 to 40 of them are sent SMS text reminders with only a small handful failing to deliver.

Results

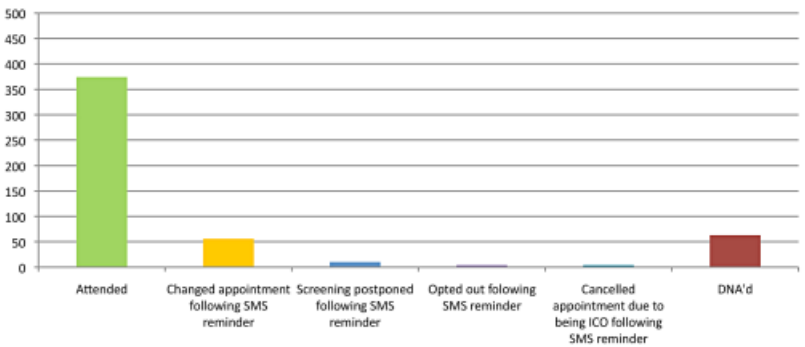
Data used in this report is from 9th October to 1st December 2014.



Overall appointments with successfully received VS failed to deliver SMS text reminder

3.2.b - Appointments which were due to take place within the reported time period	2168 patients
Successfully received SMS reminders	500 patients (23%)
Failed to deliver & unable to confirm delivery	101 patients (4.6%)
Total SMS reminders generated	601 patients (27.7%)

Patient stats following a successfully sent SMS text reminder.



Attended	374 (74.8%)
Changed appointment	56 (11.2%)
Screening postponed	5 (1.0%)
Opted out	1 (0.2%)
Cancelled appointment due to being ICO	1 (0.2%)
DNA'd	63 (12.6%)
Total'Patients'	500 patients

	Number of Patients
Number of patients that attended this year (2014) and the Year before (2013)	**267** (71.3%)
Number of patients that attended but DNA'd the year before (2013)	**26** (6.9%)
Number of new patients	**81** (21.6%)
Total Patients	**374**

Patietns who attended an appointment following a successfully sent SMS text reminder.

Patients who DNA'd an appointment following a successfully sent SMS text reminder.

	Number of Patients
New patients	**27** (42.8%)
Number of patients that DNA'd this year (2014) but attended last year (2013)	**21** (33.3%)
Number of patients that DNA'd this years (2014) and last years (2013) appointment	**5** (7.9%)
Number of patients that DNA'd this years (2014) and the last 2 years (2013, 2012)	**4** (6.3%)
Number of patients that DNA'd this years (2014) and the last 3 years (2013, 2012, 2011)	**6** (9.5%)
Total number of patients that DNA'd following a successful SMS reminder	**63** (12.6% of total SMS sent)

Failed to send SMS text reminder breakdown.

	Total Number of Patients	Number of Patients Attended	Number of Patients that changed their appointment	Number of Patients that DNA'd
Number rejected by network/SMSC	**33** (32.6%)	**18** (17.8%)	**6** (5.9%)	**9** (8.9%)
Number blacklisted by network operator	**1** (0.9%)	**0** (0%)	**0** (0%)	**1** (0.9%)
Rejected by network operator	**11** (10.8%)	**9** (8.9%)	**1** (0.9%)	**1** (0.9%)
Number invalid or inactive	**3** (2.9%)	**2** (1.9%)	**1** (0.9%)	**0** (0%)
Network operator unable to confirm delivery	**27** (26.7%)	**19** (18.8%)	**5** (4.9%)	**3** (2.9%)
Message expired on network/SMSC	**24** (23.7%)	**15** (14.8%)	**2** (1.9%)	**7** (6.9%)
Invalid Address	**2** (1.9%)	**1** (0.9%)	**0** (0%)	**1** (0.9%)
End Totals	**101**	**64**	**15**	**22**

End analysis and summary

When looking at the analysis we can see that without the SMS text reminder system a possible 63 patients (Changed appointments, Screening postponed, Opted out, Cancelled appointment due to being ICO all following SMS reminder) + 26 patients (Number of patients that attended but DNA'd the year before) = 89 patients (17.8%) of the 500 SMS reminders may have been DNA'd appointments. During the period a total of 502 patients called to rebook meaning 12.5% of the 502 patients that wanted to rebook did so following a SMS text reminder. When we look at this number against the OptoMize performance report - 3.2.b 'Appointments which were due to take place within the reported time period' which is 2,168 that's 4.1% of the patients that were booked appointments that may have DNA'd.

Having this system in place not only strengthens the DESP in terms of performance but also allows programmes operating on a closed booking system to offer more patient choice. By having the configuration set for 3 days allows programme to fill empty slots with alternative patients. We have identified a few issues with the SMS system that have been reported to the software providers (Digital Healthcare and NHS.net). Overall from looking at this data it shows how important the SMS system is in the DESP environment. Following the implementation of SMS within the Harrow DESP, we saw a rise in uptake from 82% to end Q1 2015-16 at 87.4%. We have during this time and since implemented other service improvements to continue the rise, as of Aug 2015 we're on track to surpass 88% uptake. If you have any questions or would like to see the full SMS analysis please contact me on ***ci@medicalimaging.co.uk*** or ***christopher.ingram@nhs.net***.

Erratum

March 2015 / Issue 4:

page 35, 1st paragraph, sentence two: with best VA of 6/12 or worse.
page 05, Courses and Events, DRS Training by MEH: 12th and 13th November 2015.

hisl Health Information Systems (UK) Limited

Vector Diabetic Eye Screening

- *Common Pathway Compliant*
- *Can be integrated with Vector Diabetes Management & Vector Medical Retina (or linked to Medisoft)*
- *Comprehensive failsafe techniques*
- *Patient workflows making system intuitive to use*
- *Team experienced in importing legacy data and images from other systems*
- *Full national reporting capability*
- *Query Engine for ad-hoc reporting requirements*

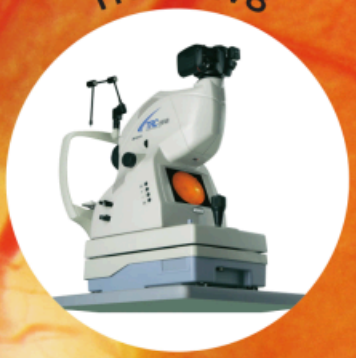
Vector **Diabetic Eye Screening** is part of the Vector Long Term Care / Chronic Disease Management EPR platform. Other disease areas include Diabetes Management, Endocrinology, Lipids, Sickle Cell, Medical Retina, AMD, Hypertension, Rheumatology, Podiatry, and Cardiac Rehab

Please contact Steve Courtney
steve.courtney@hisvector.com
Mob: 07768 964689

Your choice is clear

3D OCT-1 Maestro

TRC-NW8



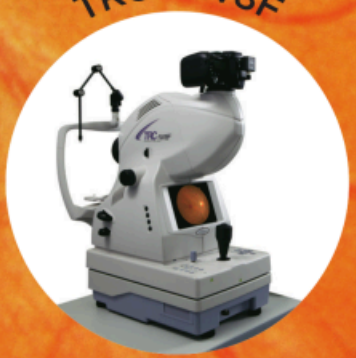
3D OCT-2000

Probably the widest range of Fundus cameras approved for diabetic screening

TRC-NW400

3D OCT-2000FA+

TRC-NW8F



TRC-NW8FA+

For more information, contact Topcon today

TOPCON GB Limited
- t: 01635 551120
- medical@topcon.co.uk
- www.topcon-medical.co.uk

TOPCON IRELAND
- t: 01897 5900
- medical@topcon.co.uk
- www.topcon-medical.ie

TOPCON