

Delivering Subspecialty Health Care to Rural India using the Mobile Phone

-The Narayana Nethralaya Experience in Tele-Ophthalmology



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National Broadband Initiative

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Why ‘Subspecialty Care’ ?

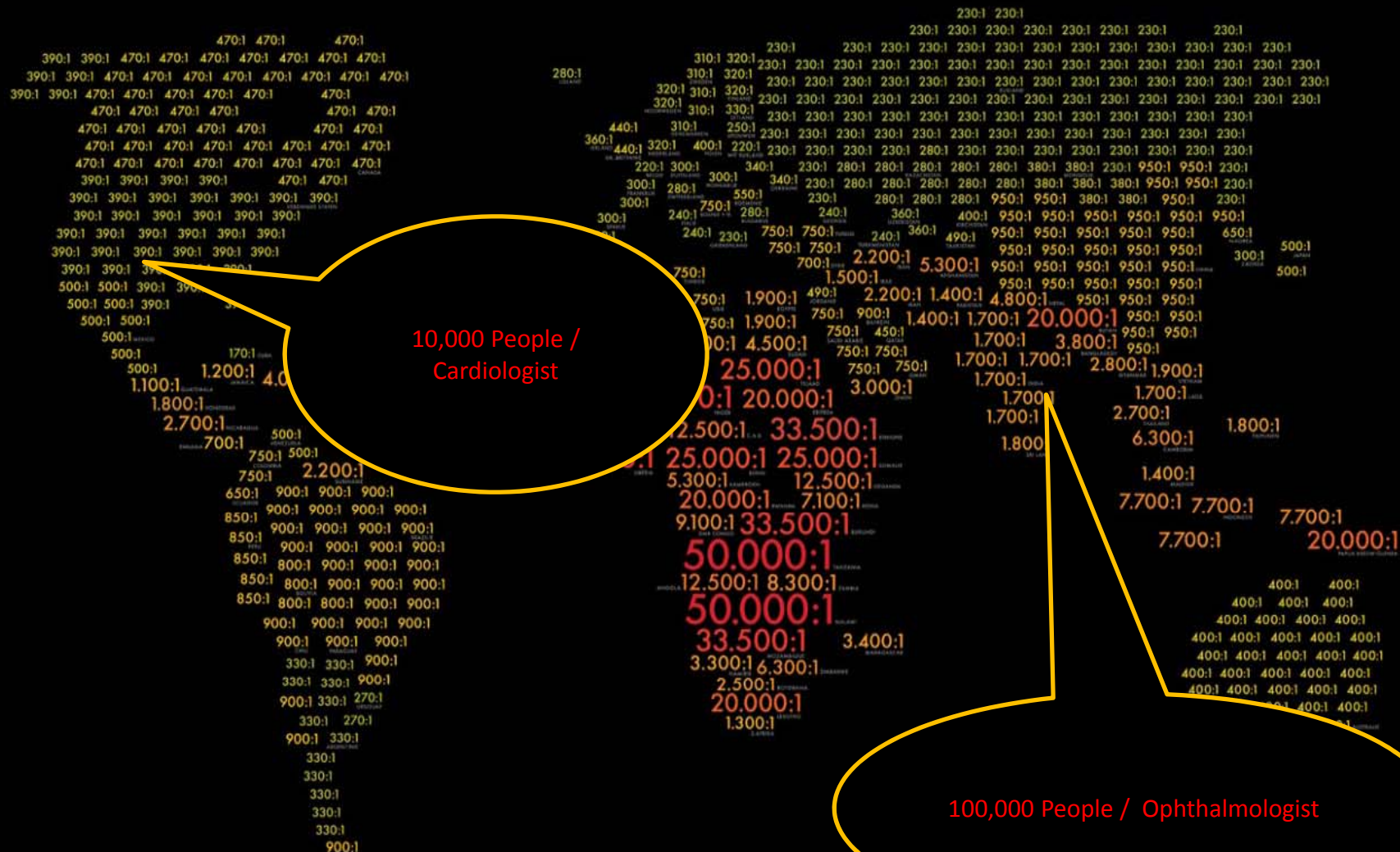
- 74% Rural Population
- Inadequate health care delivery services – Primary Health Care (PHC) & Community Health Care (CHC). Limited private enterprise
- “Experts” in few large cities – NO access to the rural masses

Fields in Medicine that rely on Image Based Diagnosis

Specialty	Dependence on Images
Dermatology	70% (need to touch and feel)
Radiology	80%
Ophthalmology	> 90%

Number of Inhabitants / Doctor

NUMBER OF INHABITANTS PER DOCTOR



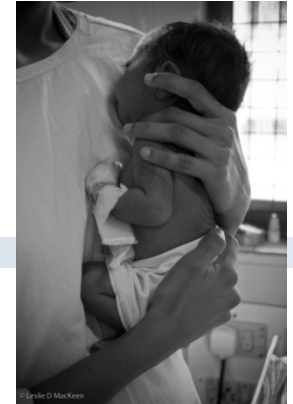
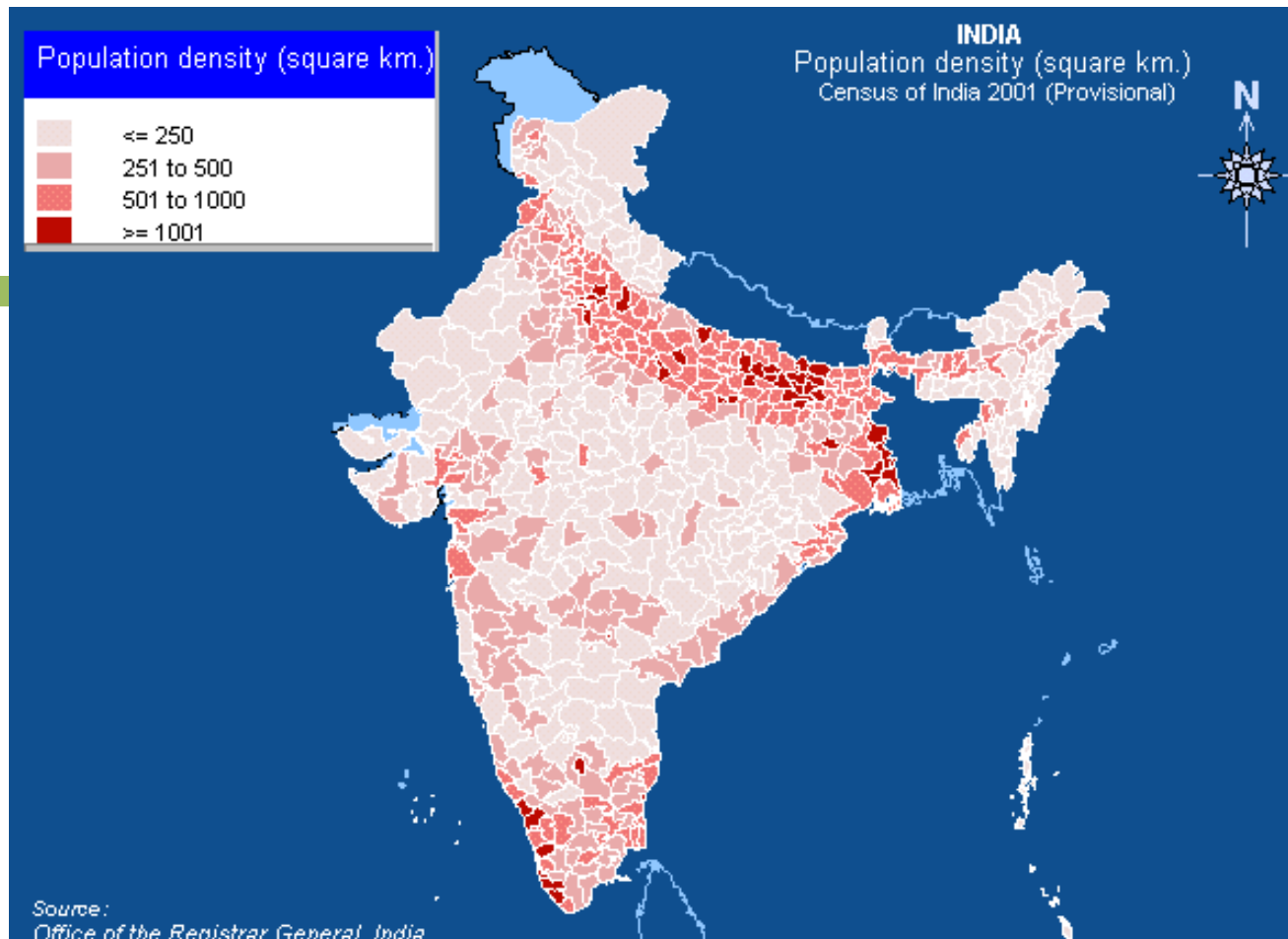
Source | The World Health Report 2008



Not everybody in this world can see a doctor when in need. This is even more so in areas where people suffer from famine, war and diseases. Doctors of the world aims to provide everybody in this world with at least the most essential medical care. Help the people the world is slowly forgetting.



www.doctorsoftheworld.nl



Population: 1.2 billion

Doctor: Population ratio 59:100,000 (GOI,2001)

Vitreo-Retinal Surgeons : 340 (VRSI membership,2008)

Pediatric Retina Specialists : < 15

Tele-Ophthalmology – Narayana Nethralaya Experience

- **Retinopathy of Prematurity**
- **Largest cause of infant blindness in developed countries**
- **India is suffering from the “Third Epidemic”**



Tele-Ophthalmology – Narayana Nethralaya Experience

- **Affects Preterm & Low Birth Babies (< 2000 g)**
- 47% of Infants (< 1750) suffer from “some ROP”
- 15% of these will turn BLIND if not treated



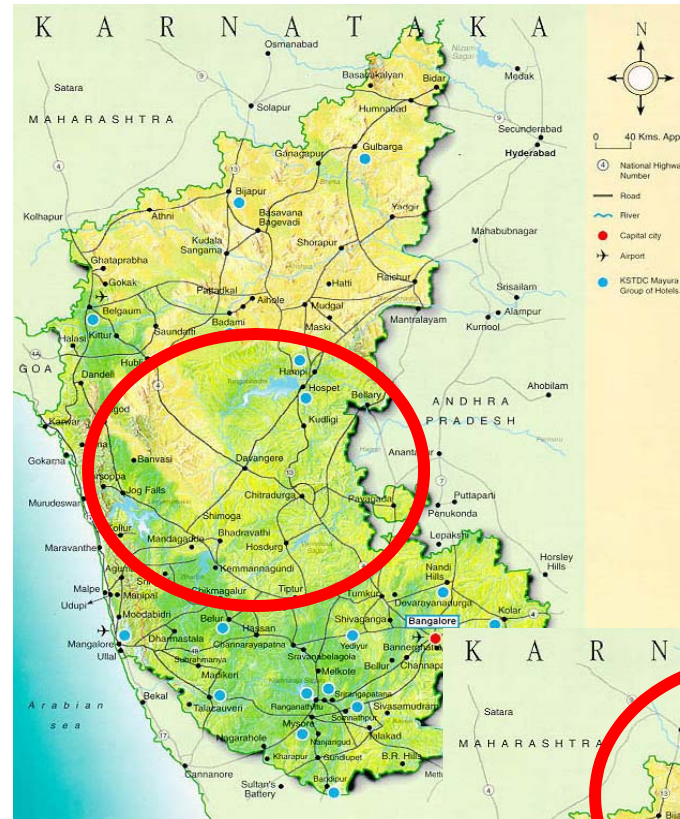
- Blindness Preventable if Detected “On Time” and timely treatment is given
- Problem: < 350 Qualified Retinal Surgeons in India
- 2 million babies born < 2000 grams every year





Every two hours 3 infants reach
threshold for treatment in India*

** Extrapolation based on GOI Data (2007) and PGI, Chandigarh, NICU Incidence*



Narayana Nethralaya **KIDROP** Trial (Karnataka State Internet Assisted **D**iagnosis of **ROP**) 2007 to date

Narayana Nethralaya Initiative

Triple I Strategy



- Tele- ROP
- Train peripheral ophthalmologists (ROP fellowship)
- Talking to and Training pediatricians & gynecologists

Transporting Equipment to the Periphery



Districts Covered Thus Far



Day	District	Distance (Kms)
Mon	Mandya, Mysore, Chamrajnagar	320
Tue	Bangalore BBMP	50
Wed	Tumkur dist Hosur (TN)	220, 80
Thu	Kolar	152
Fri	Tumkur Pavagada	141
Sat	Bangalore Urban	68
Sun	-	-

RETCAM IMAGING IN THE PERIPHERAL NICU

Technicians Trained to image, save, retrieve and analyze the images

The images are uploaded to the website for remote “Readers”

Technician may become the ‘first point of health care’ for the infant and mother

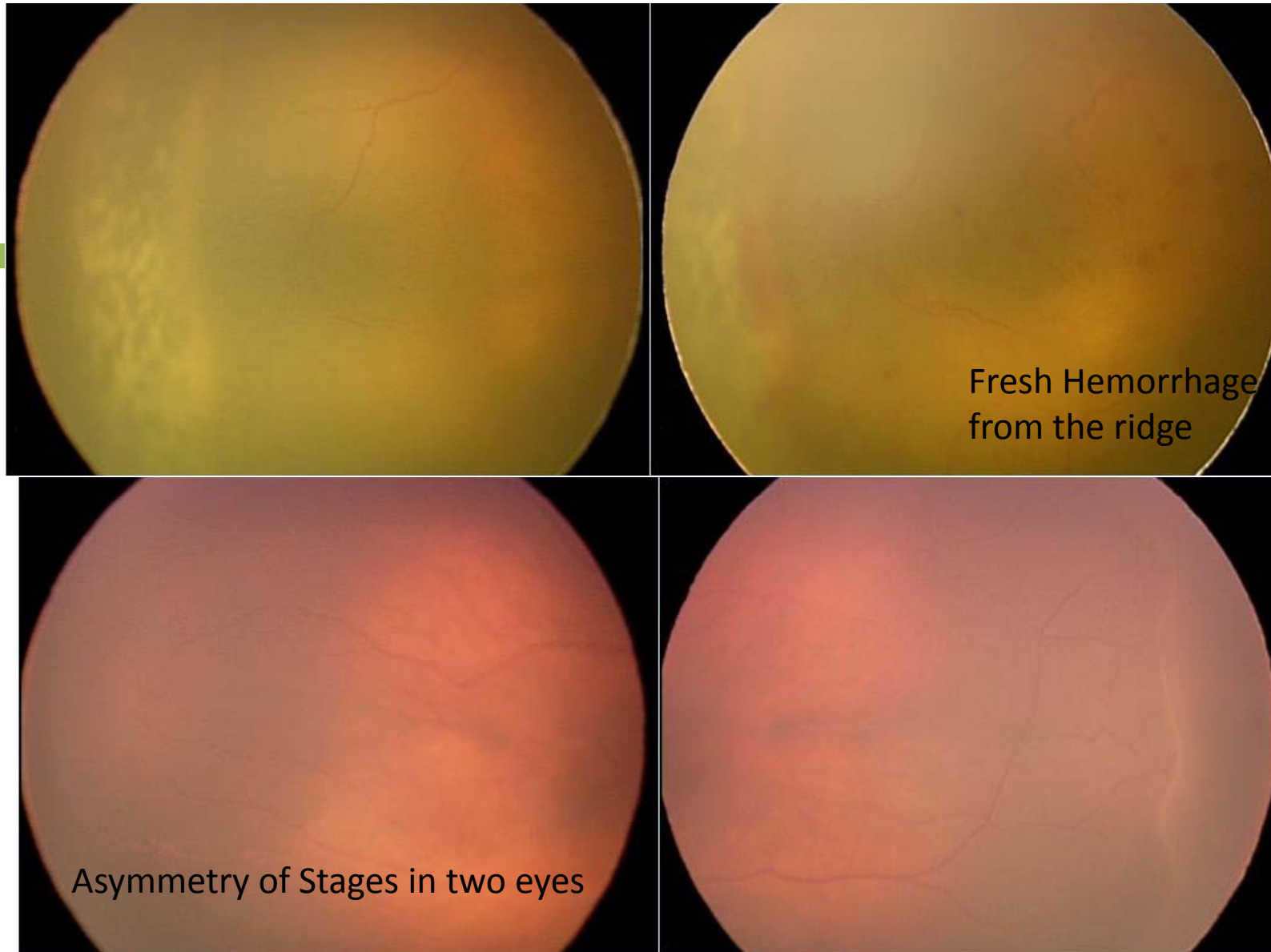


Technician's Decision Algorithm – Both eyes imaged*

mature vessels upto temporal ora	mature vessels upto temporal ora	Discharge
mature vessels upto temporal ora	immature	Follow-up
immature	immature	Follow-up
immature	regressing	Follow-up
stage 1, zone 2 or 3, no plus	similar or less (reg, immat, mature)	Follow-up
stage 2, zone 2 or 3, no plus	similar or less (stage 1, reg, immat, mature)	Immediate referral to MD
plus disease with any stage, any zone	any finding	Immediate referral to MD
any zone 1 disease	any finding	Immediate referral to MD
aprop	any finding	Immediate referral to MD



Capturing 360 degree ORA SERRATA



Comparing Images between TWO sessions to aid diagnosis

Characteristics of a good “Tele” Tool

- “Loss-Less” transfer of images – real time
- Mobility : PC based or Mobile Phone?
- Quick to install, Easy to use and SECURE
- Disease specific templates
- Multiple consults – teaching and training

Peripheral Centre:

Uploader User Interface

**ABO Compression
Technology:**

Select images that are acquired from an imaging modality like CT, MRI, Ultrasound, Mamograms, etc.

Images acquired from Modality

Scanned Documents

ECG Files

Patient Photos

Other Files

Patient Information

Review & Upload

Add

Add Folder

Remove

Series No 1

Headquarters:

Viewer User Interface

MatrixView
Powered by ABO

MviStream
thin . secure . fast

Worklist Adm

Filter

Patient ID : Hosp. Name : From Date (mm/dd/yyyy) : 09/04/2009 Modality : All Search Clear Search

Patient Name : Ref. Dr. : To Date (mm/dd/yyyy) : 09/04/2009 Select By Date Delete Study

Select	Patient ID	Name / Sex / Age	Mod	Date	Status	Ser / Img #	Ref. Dr	Hosp Name	Alerts
☐	55555555	Rajan / M / 0	SC	04-Sep-2009 12:59 PM	Viewed	1 / 1	NN	NN	
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☐	1002	Ramakanth / M / 0	SC	04-Sep-2009 12:40 PM	Viewed	2 / 16	Dr.Arjun	NN	High Importance
☐	1002	Ramakanth / M / 0	SC	04-Sep-2009 12:40 PM	Viewed	2 / 16	Dr.Arjun	NN	High Importance
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1

Choose Filter : Default

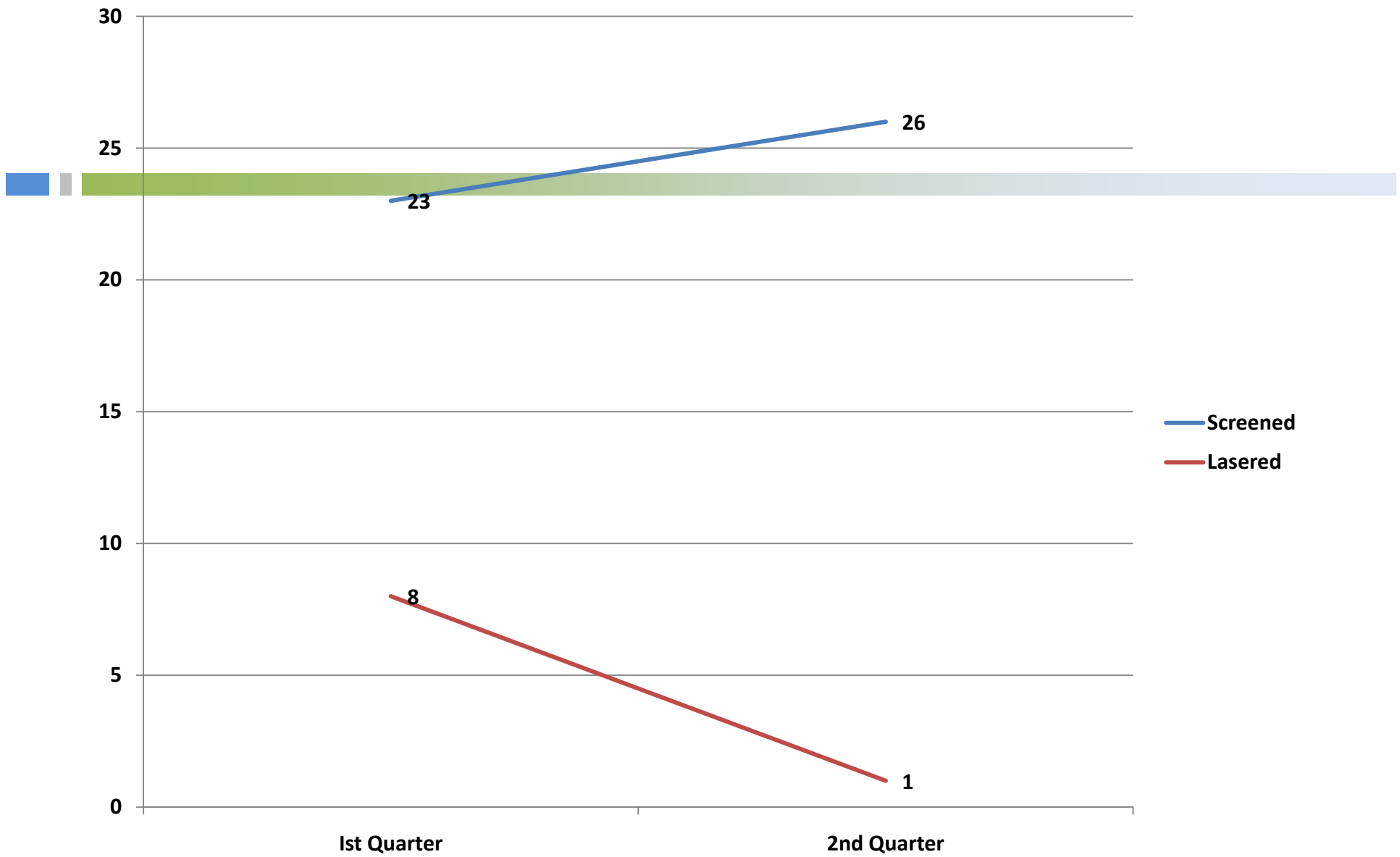
Assign To : poornima () Assign

Image Review



1908 infants: 14 months : 18 Centres: 350 km radius

	No of babies screened	Birth Weight (grams)	Period of Gestation (weeks)
TOWN (M) TOWN (MA)	387	1322	31.1
RURAL 1 (A)	146	1496	32.9
RURAL 2 (K)	442	1366	31.6
RURAL 3 (T)	199	1502	32.9
URBAN 1 (MSR)	436	1198	30.1
URBAN 2,3 (P)	298	1298	31.0



Expansion

- NRHM – Narayana Nethralaya PPP for 6 more districts
- Since September 2009 – Three batches, ongoing
- Expansion to other states
- Thailand, Kenya, Ghana, Bhutan, Srilanka



Estimated ROP Case Load

Sl. No	6 C category District	No. of Taluk	Population	No. of PHCs	Deliveries (08-09)	No. of Premature/ LBW deliveries (10%)	ROPs of col no. 7 (50%)	ROPs requiring treatment (15%)	Cost of ROP treatment (@ Rs. 4000/case)
1	2	3	4	5	6	7	8	9	10
1	Bidar	5	1740031	41	34228	3423	1712	257	1028000
2	Gulburga	10	3660387	108	81199	8120	4060	609	2436000
3	Raichur	5	1969521	43	34544	3454	1727	259	1036000
4	Koppal	4	1401644	47	21589	2159	1080	162	648000
5	Bijapur	5	2061418	63	43168	4317	2158	323	1292000
6	Bagalkot	6	1896918	46	37242	3724	1862	280	1120000
	Total	35		348	178890	25197	12599	1890	7560000



Ophthalmology Times – Europe, October 2009



Tele-ophthalmology model for ROP management

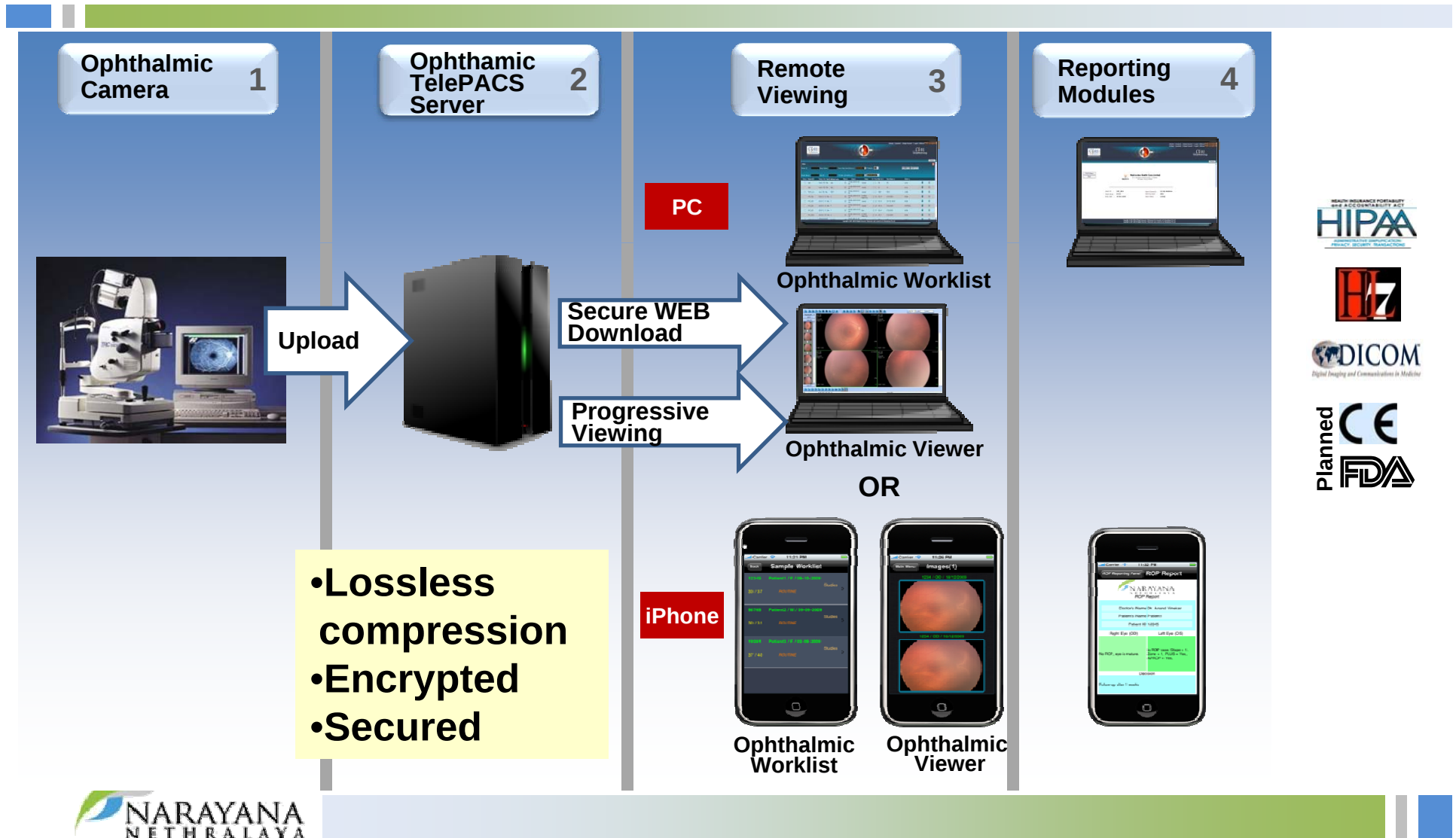
By Anand Vinekar, MD, FRCS

Dr Anand Vinekar describes how tele-ophthalmology models for ROP can be used in developing countries, using a successful Indian programme as a case study.

“... A possible model for middle income countries.” – OT, Europe

Tele PACS

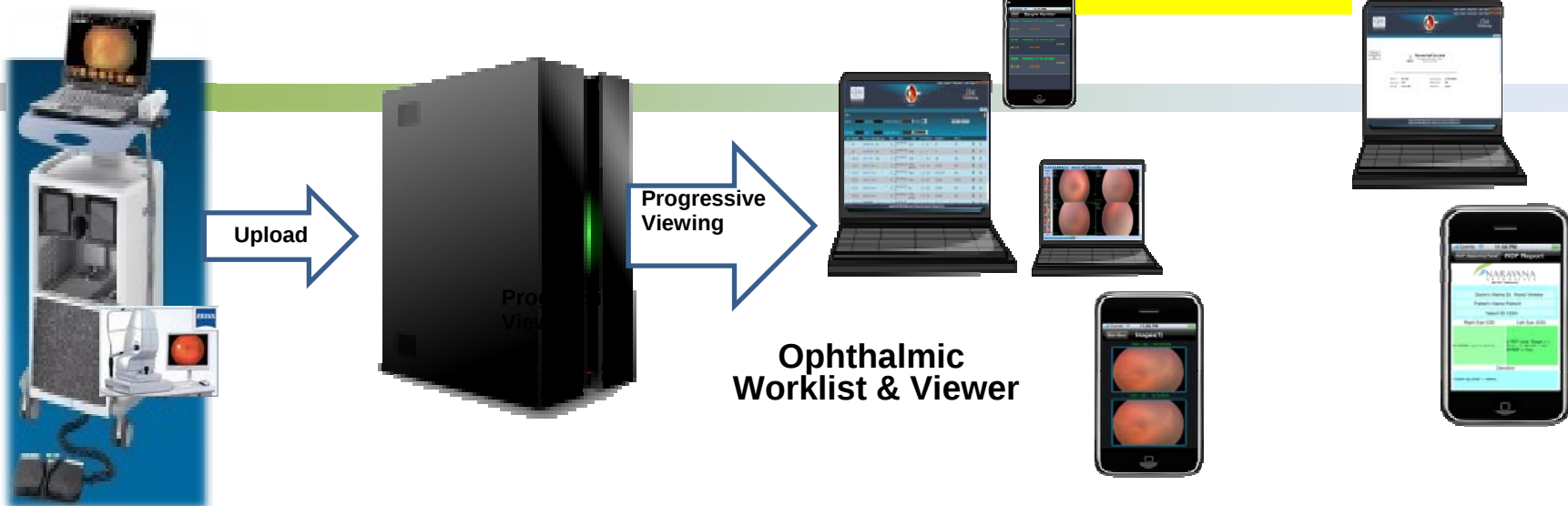
- Efficient workflow
- Compare prior studies for progressive disease evaluation



**Ophthalmic
Camera**
PATIENT SITE

**Ophthalmic
TelePACS
Server**

**Remote
Viewing**
ANY SITE
ANYWHERE



- Studies captured by digital Fundus camera
- Uploader installed on Fundus camera workstation
- Uploader encrypts, compresses losslessly and transmits Studies to Server over LAN or WAN

- Stores Studies for download.
- Provides user services over the WEB such as:
 - Viewer download
 - Worklist creation
 - Workflow management.
 - Admin functions
 - User authentication

- Remote Ophthalmologist logs-in at the Server over WEB.
- Downloads viewer one time from server.
- Downloads worklist from server.
- Selects studies to download from the worklist.
- Downloads studies realtime and progressively views
- Uses Viewer tools to analyze images.

- Creates reports via WEB reporting feature or Word upload.
- Electronically signs and sends to Patient Site or forwards to consultant.



iPhone Log-In Screenshots



Your
institution
here



iPhone Worklist



List of studies for
review

History of Visits for
Particular Patient

Patient Information



iPhone Viewer Screenshots

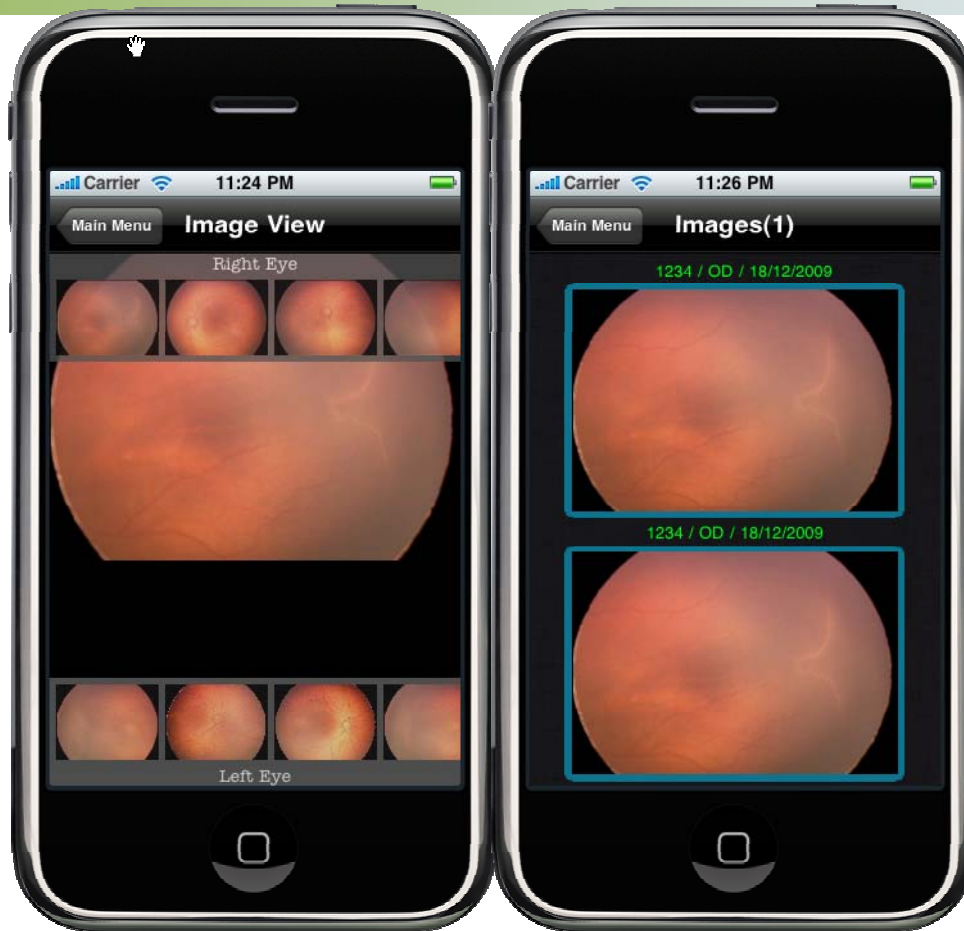


Image with
Thumbnails

Compare
Images



iPhone Reporting Flow

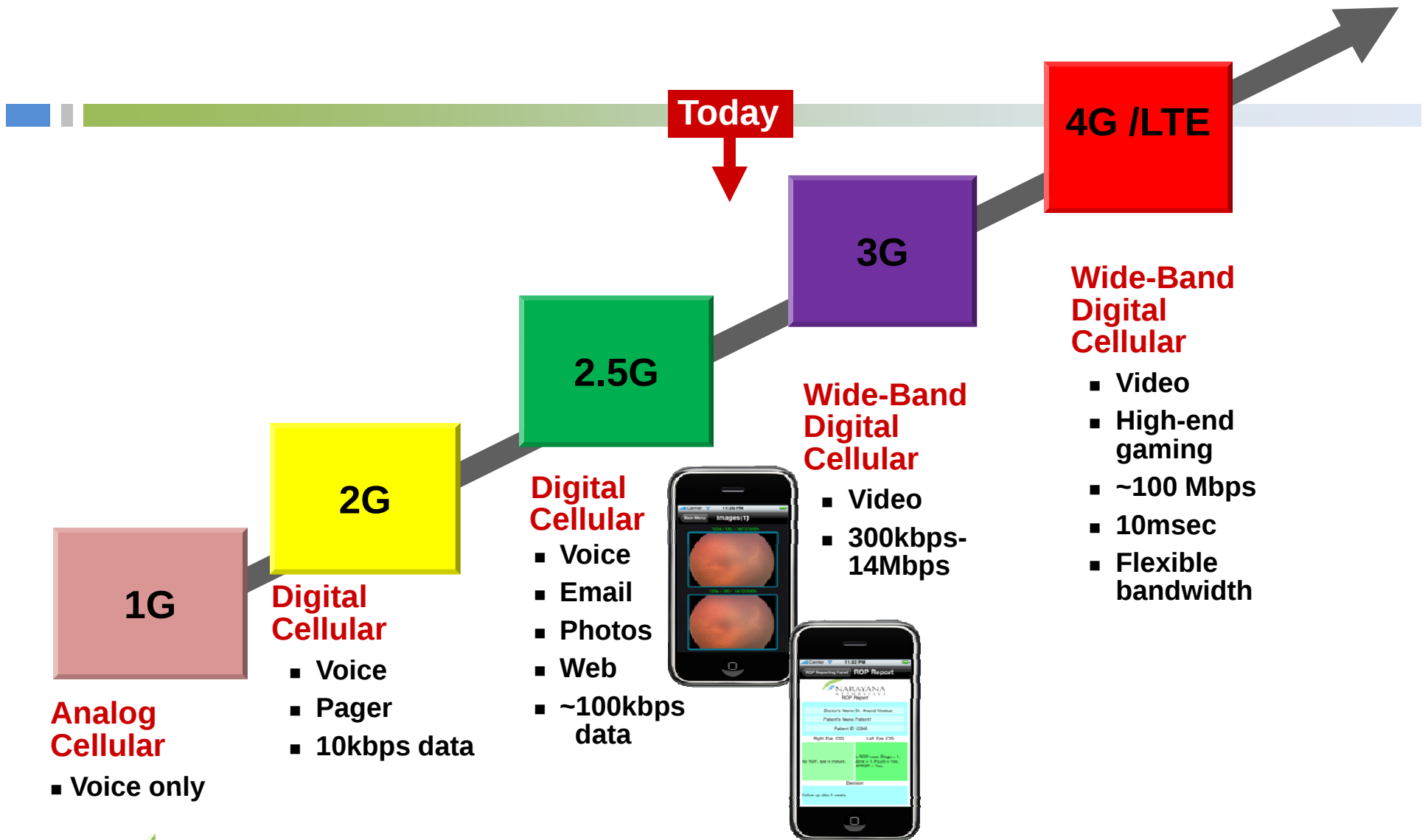


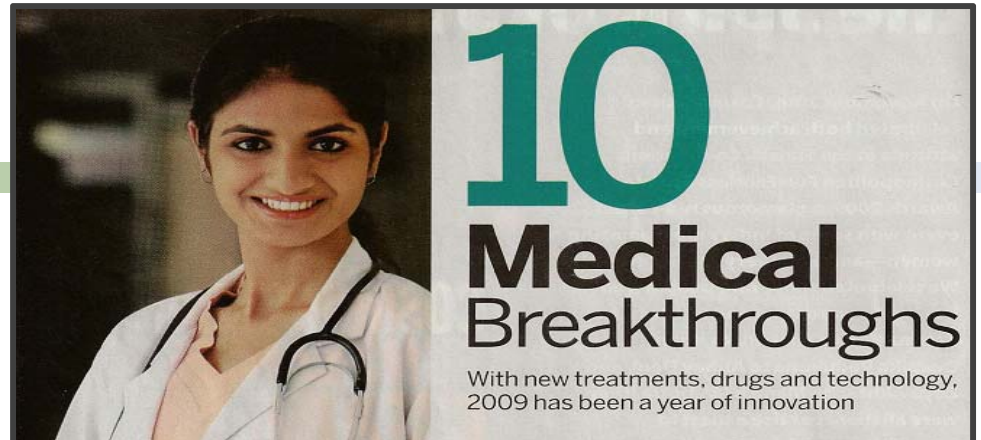
PC vs Cell Phone

Remote Image Viewing

PC Based	Mobile Phone
Internet Required	Network – 2G, 3G
Variable speeds – rural areas	Better coverage
Less Mobility	Anywhere, Anytime
Resolution – better?	Improving – “Nearly As Good” - validation
Size	Convenient – Pocket size

Wireless Market Evolution





6. Sing a different tune

iPhone used to stave off blindness

Who would have thought that the pricey Apple iPhone could help India's rural masses? But doctors at the Narayana Nethralaya Postgraduate Institute of Ophthalmology, Bangalore, are doing precisely that to diagnose vision loss in infants from remote areas. Over 8 per cent of India's 27 million infants each year weigh less than 2 kg and run the risk of Retinopathy of Prematurity. So long just a handful of city doctors had the know-how. Now ***with the iPhone and a software developed by the i2i TeleSolutions***, the good doctors are busy saving lives across the country.



iPhone may well be nicknamed "Eye-Phone" among pediatric eye surgeons starting off on a global endeavor to prevent

an eye disease that affects thousands of prematurely born infants and can cause blindness if not swiftly treated. It's not a feature Steve Jobs -- much less anyone -- could have envisioned, but pediatric eye (retina) surgeons in India and elsewhere say that when using tele-ophthalmology to cure a disease called Retinopathy of Prematurity (RoP), they find the iPhone to be the best platform from both a security and features perspective.

"Some babies born underweight are likely to be affected by RoP, which though curable, must be acted upon in a matter of days to prevent irreversible blindness.

This is especially a problem in countries such as India and those of a similar socio-economic nature, where lack of adequate facilities, long distances, illiteracy and low accessibility to quality healthcare cause thousands of children to become blind every year," said Anand Vinekar, project coordinator and pediatric retinal surgeon at Narayana Nethralaya, an ophthalmological institute based here.

Laboratory assistants take pictures of the retinas of prematurely born babies and transmit them via broadband to pediatric eye surgeons, who could be hundreds or thousands of miles away.

These surgeons, using iPhones, enlarge the images and using the iPhone's graphics capabilities determine whether the baby needs immediate help.

Need for a standard platform

"We wanted a standard platform and the iPhone proved to be the best. With other (GSM) handsets you find that different models have different features. With a Nokia for instance, you have many models which do or do not have all the features we need. So it was easy to standardize on the iPhone," Vinekar said. The iPhone's large screen, resolution, graphics capabilities and features offered the good picture quality doctors require, and security in the form of easy-to-publish Adobe software -- which also helps to upload patient records immediately and securely, Vinekar said.

In addition to the graphics processing capabilities that the chip industry has provided through the iPhone, it is chipping in with the software used in treating RoP. This comes from [i2i Telesolutions](#), a startup launched by an ex-Texas Instruments India executive, Sham Banerji. Banerji led the team that developed the first DSP in India while at TI in Bangalore.

"The iPhone's pinch-and-drag capabilities, apart from its amazing resolution, are unrivaled in other phone models and the surgeons therefore decided that this is best-suited for this kind of application," Banerji said.

In India alone, thousands of children go blind every year. These numbers could fall as a result of efforts by Vinekar and others like him, along with the help of the government.

Currently, Vinekar, with surgeons such as Anna Ills of Calgary, Canada, are joining with regional governments and non-governmental bodies to use the broadband and the iPhone to fight blindness in newborns everywhere in the world.

Min of External Affairs – India Perspectives (Jan -Feb 2010)



“... a unique experiment in Tele-Ophthalmology provides hope to rural infants”

The Future

- Integrating Tele-diagnostic equipment
- 3G - > 4G - >x G? Faster, More secure
- Disease and Specialty Customization
- Live Webcasts, Video-Conf on the Phone, Multi sessions





The Truth Is out There....



NETHRALAYA

THANK YOU

Working towards a
world without ROP
blindness*

** Video on YouTube*