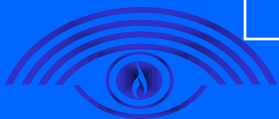


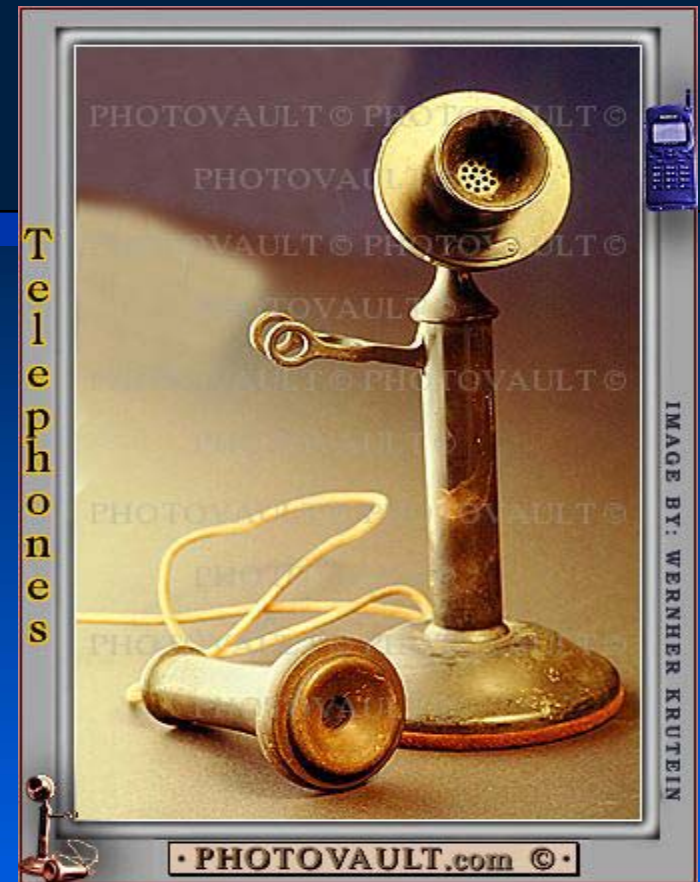
# Aravind Teleophthalmology Network - ATN

Dr.Kim  
Program Director  
ATN  
Aravind Eye Care System  
Madurai

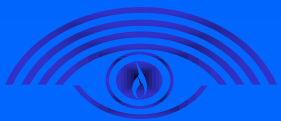


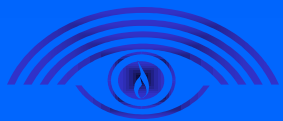
# Over the years...

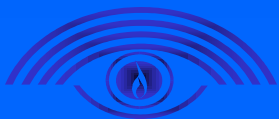
...doctors interacted with each other to get second opinion using the available communication technology



**Invention of Telephone changed the way people lived!**







# Tele-ophthalmology

....breaking the distance barriers

- A system that electronically transports a consulting Physician from a medical center to a site at a distant facility where his/her expertise is required

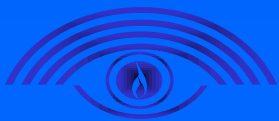
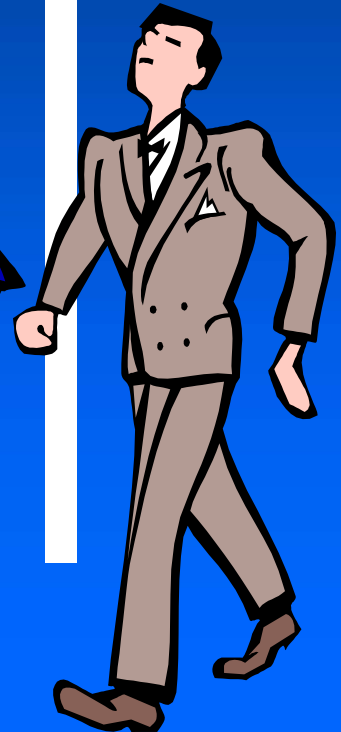
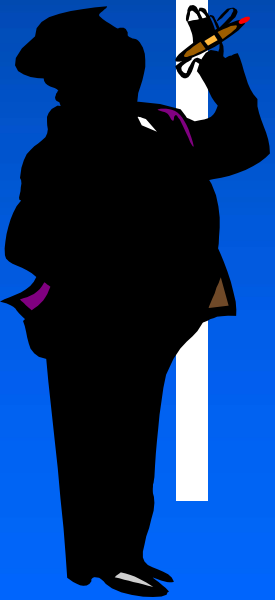


**ARAVIND EYE CARE SYSTEM**

# *Geography is History*

??

IRIDIUM



# Why Tele-ophthalmology?

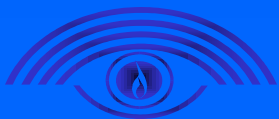
- Ophthalmic diseases are mostly diagnosed by viewing still images
- Like in radiology, ophthalmology is apt for telemedicine





# Telemedicine levels of eye care delivery

- Primary eye care – Screening for common eye diseases
- Secondary
- Tertiary



# In Primary eye care

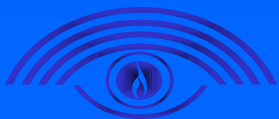
---

- Rural internet kiosks



# Internet kiosks

- Multiple internet kiosks have been started in remote villages.
- Have internet access through WLL (Wireless Local Loop)
- Run by the local person trained for this purpose
- Self sustaining
- Income generation
- Resource center – one of it, is the eye care service



# Taking eye care to doorsteps...

## n-Logue: Internet Kiosks



# Taking eye care to doorsteps...

## n-Logue: Internet Kiosks



# Secondary Care

---

- Vision Centers
- Mobile screening unit



# Aravind Vision Centres

1. Comprehensive primary eye care in rural area
2. Exploiting IT for rural eye care service delivery
3. Tele-consultation: Vision centre technician with ophthalmologists
4. Available on a permanent basis
5. Refraction and school screening
6. Community participation

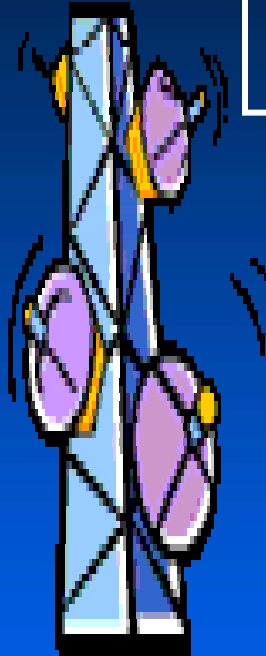
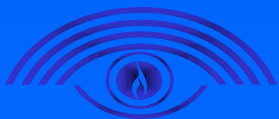


# Tele-consultation

Wireless connectivity  
@ 4mbps

Consultation by  
Ophthalmologist at  
Aravind Eye Hospital,  
Theni

Screened by  
paramedic at Vision  
Centre





# Vision centres currently at:



Ambasumithram–April 2004  
(10 KM from Theni)



Andipatti – Dec 2004  
(7 KMs from Theni)



Bodinayakanur – Sep 14<sup>th</sup>  
2005  
(16 KMs from Theni)



Chinnamanur– March 20<sup>th</sup>  
2006  
(25 KMs from Theni)



# Technology



WiFi 802.11b

Low cost

Unidirectional  
antenna

Line of Sight

Upto 25Kms.



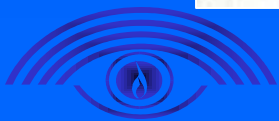
# Innovation - Reducing the cost Thinking out of the box Designing equipment for the masses



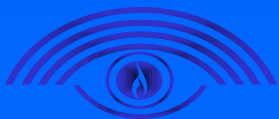
## Additional Investment:

- Cost of adapter rings: US\$ 10 (about Rs. 500)
- Now this is used in village level Vision Centres

Investment for existing fundus camera  
US\$ 20,000 to 25,000 / Rs. 9 - 11 Lakhs



# Eye Screening going mobile!!





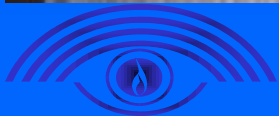
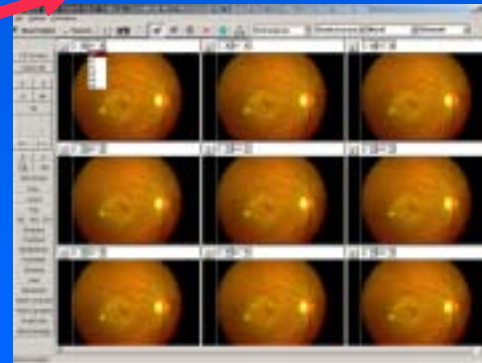
# Mobile Screening Van

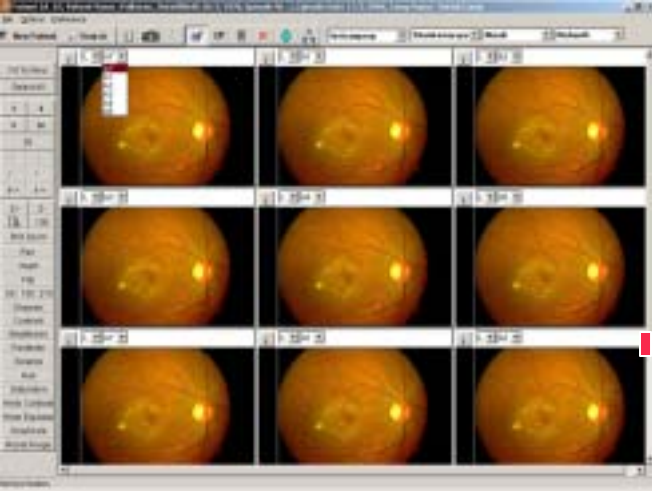


- Goes to remote places
- Known diabetic pts. Are collected by the local physician
- Fundus images in a defined protocol are taken
- Recorded in a specialized software and transmitted to the Reading Grading Center at the Base Hospital



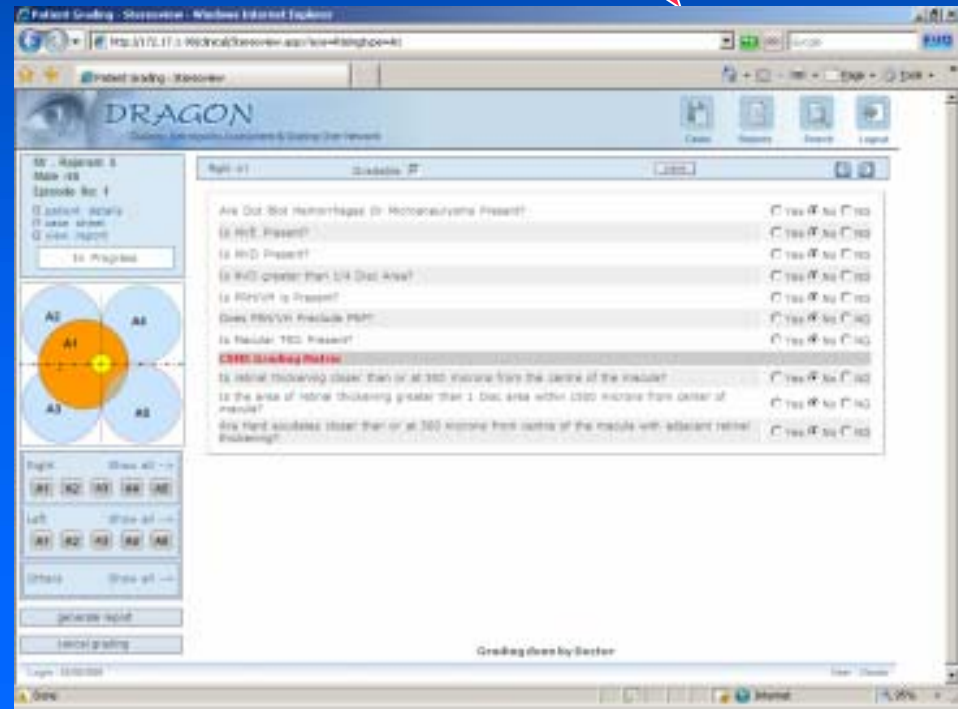
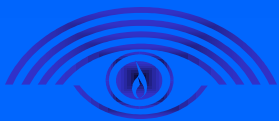
Then the system packs the images, (DICOM Standard) and the demographic details of the patient and uploads it to the central server through satellite.



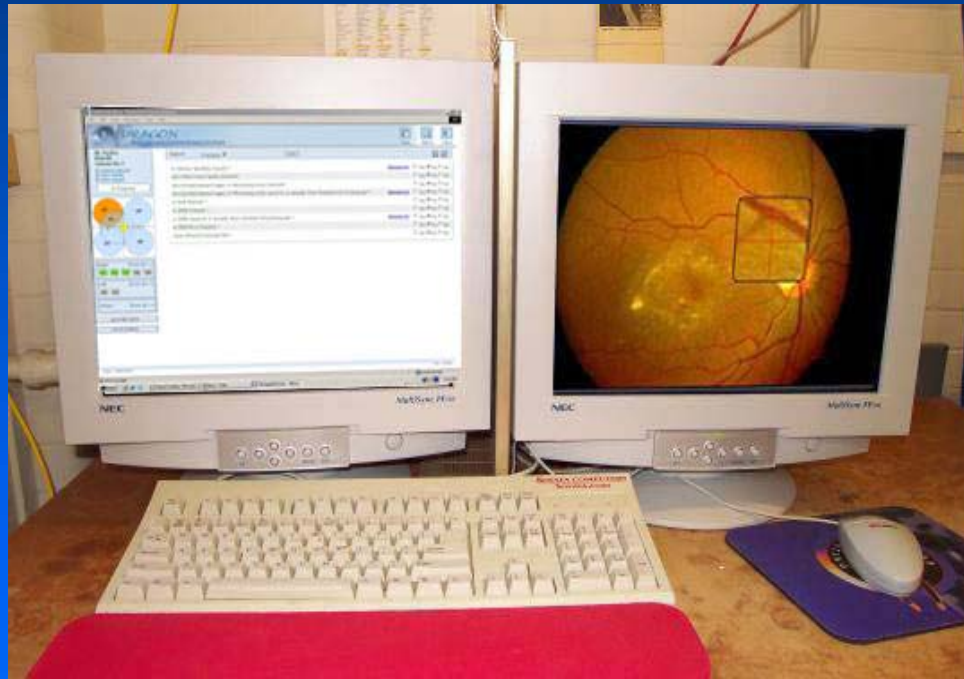


Grading centre in the  
base hospital

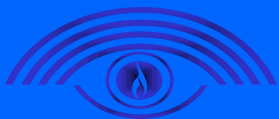
Each set of images have  
set of questions based  
on ETDRS criteria



The reader can select a patient, look at each image one by one and record his observations in the system itself.



For ease of use, the images are loaded full screen in one monitor and the input forms are loaded in another monitor





# In the second monitor, the reader enters the inputs for grading

The screenshot shows the DRAGON web application interface. The header includes the logo and title "DRAGON Diabetic Retinopathy Assessment & Grading Over Network". The main content area is divided into several sections:

- Left Sidebar:** Contains patient information for "Mr. Kantha Male/09 Episode No: 1", navigation links for "patient details", "case sheet", and "view report", and a status indicator "In Progress". Below this is a diagram of the retina divided into five quadrants: A1 (top-left), A2 (top-right), A3 (bottom-left), A4 (bottom-right), and A5 (center). A yellow dot is visible in the center (A5).
- Right Panel:** Displays a list of clinical questions for grading, such as "Is Venous beading present?", "Are Cotton Wool Spots present?", and "Are Dot Blot Hemorrhages Or Microaneurysms Present?". Each question has a "Standard" link (e.g., "Standard 0A") and radio button options for "Yes", "No", and "NG".
- Bottom Left:** Contains controls for "Right" and "Left" eye views, with buttons for "Show all" and "cancel grading".

Three blue callout boxes with arrows provide additional information:

- Top Callout:** "Lesions are predefined for each quadrant" (points to the A1-A5 diagram).
- Middle Callout:** "Standard Images for comparison" (points to the "Standard 0A" link).
- Bottom Callout:** "To track which fields are already graded" (points to the "cancel grading" button).

The bottom of the screen shows a Windows taskbar with the Start button, several open applications (Patient Grading, Inbox, ImageActivex), and the system clock showing 3:16 PM on 10/04/2005.

- Standard images used for comparison as required.
- The standard images are displayed when the user clicks on the standard image thumbnail present in the grading screen.

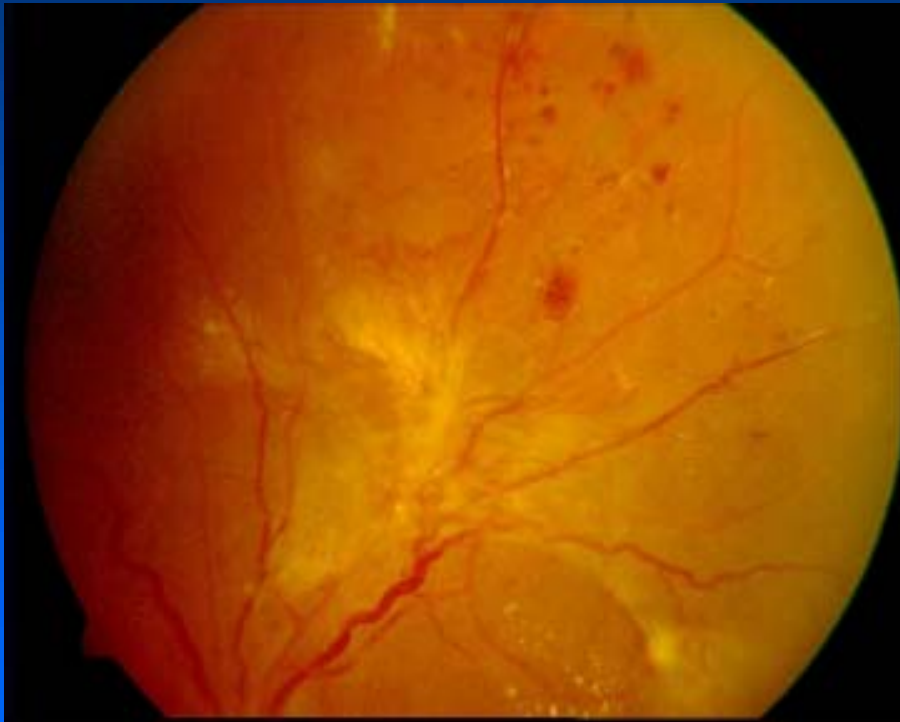
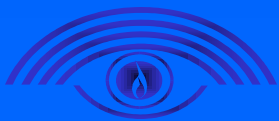


Image to be graded



Standard Image



# Report

Once all the images are graded, the system automatically generates a report with possible treatments, based on the observations made.

The screenshot displays a web browser window titled "Grade Result - Microsoft Internet Explorer". The address bar shows "http://172.17.1.18/dragon/engraderesult.aspx". The main content area features the "DRAGON" logo and the text "Diagnosis, Anisotropy Assessment & Grading Over Network".

On the left side, a sidebar displays patient information: "Mrs. Neelani A", "Female/55", "Episode No: 1". Below this are links for "patient details", "case sheet", and "view report", along with a "Report Sent" button. A diagram shows five overlapping circles labeled A1 (center, orange), A2 (top-left, light blue), A3 (bottom-left, light blue), A4 (top-right, light blue), and A5 (bottom-right, light blue). Below the diagram are sections for "Right", "Left", and "Others", each with "Show all" links and buttons labeled A1 through A5.

The main report area is titled "Grading Result Prepared by doctor" and includes a "Reader" dropdown menu. It features the logo for "ARAVIND EYE CARE SYSTEM, MADURAI". The report is divided into two columns: "Right Eye" and "Left Eye".

**Right Eye:**  
Diagnosis : Mild NPDR  
Treatment Advised:  
Optimize Medical Therapy of Glucose  
BP  
lipids  
Comments:

**Left Eye:**  
Diagnosis : Mild NPDR- With CSME  
Treatment Advised:  
Optimize Medical Therapy of Glucose  
BP  
lipids  
Comments:  
LE FOCAL

At the bottom of the report, it states "Suggested Followup: 4 to 6 Months".

Reader can overwrite the diagnosis (if needed), add his comments and attach the critical images to be printed along with the final report



Grade Result - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://172.17.1.108/agn/gradeResult.asp

# DRAGON

Diagnostic, Assessment, Assessment & Grading Over Network

Case Reports Search Logout

Grading Result Prepared by doctor Reader - Select -

ARAVIND EYE CARE SYSTEM, MADURAI

**Right Eye**  
 Diagnosis : MID NPDR  
 Treatment Advised:  
 Optimize Medical Therapy of Glucose  
 BP  
 lipids  
 Comments:  
 Suggested Followup: 4 to 6 Months

**Left Eye**  
 Diagnosis : MID NPDR - WITH CSME  
 Treatment Advised:  
 Optimize Medical Therapy of Glucose  
 BP  
 lipids  
 Comments:  
 LE FOCAL

Report Sent

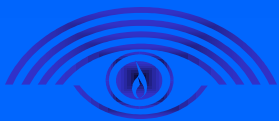
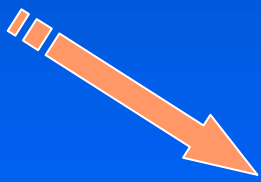
Right: Show all ->  
 A1 A2 A3 A4 A5

Left: Show all ->  
 A1 A2 A3 A4 A5

Others: Show all ->

Login: 2008/02/05

Done Local intranet





# Admin can add and maintain users

The screenshot shows the DRAGON web application interface in Microsoft Internet Explorer. The browser title is "Diabetic Retinopathy Reading and Grading Centre - UserManagement - Microsoft Internet Explorer". The application header includes the DRAGON logo and navigation icons for Cases, Reports, Search, Admin, and Logout. A left sidebar contains a menu with items: Admin, Camps, Users, Client, Severity, Treatment, Followup, Lesions, Diagnosis, and Configuration. The main content area is titled "Manage User -> Add User" and contains a form with the following fields:

- User Id\*: jclark
- User Name\*: jim clark
- Password\*: [masked]
- Email\_Id\*: jclark@gmail.com
- UserType\*: Administrator (with a dropdown menu showing options: Administrator, Senior Medical Officer, Reader)


At the bottom of the browser window, the login information "Login: 2/16/2008" and "User: admin" is visible. The Windows taskbar at the bottom shows the Start button, several open applications (Diabetic Retinopathy, report - Paint), and the system tray with the date and time "3:33 PM".



# Manage lesions

Diabetic Retinopathy Reading and Grading Centre - View Lesions - Microsoft Internet Explorer

File Edit View Favorites Tools Help



Cases Reports Search Admin Logout

**Admin** Manage Lesion -> View Lesions Add

Lesion Name	Field	Provisions	Provisions
Are Dot Blot Hemorrhages Or Microaneurysms Present?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Are Hard exudates closer than or at 500 microns from centre of the macula with adjacent retinal thickening ?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Does PRH/VH Preclude PRP ?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Is Macular TRD Present ?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Is NVD greater than 1/4 Disc Area?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Is NVD Present?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Is NVE Present ?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Is PRH/VH is Present ?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Is retinal thickening closer than or at 500 microns from the centre of the macula ?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Is the area of retinal thickening greater than 1 Disc area within 1500 microns from center of macula ?	A1	<a href="#">Edit</a>	<a href="#">Delete</a>
Are Cotton Wool Spots present?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>
Are Dot Blot Hemorrhages Or Microaneurysms equal to or greater than Standard 2A Photograph?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>
Are Dot Blot Hemorrhages Or Microaneurysms Present?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>
Does PRH/VH Preclude PRP ?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>
Is IRMA equal to or greater than Standard BA photograph ?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>
Is IRMA Present ?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>
Is NVE Present ?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>
Is PRH/VH is Present ?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>
Is Venous beading present ?	A2/A3/A4/A5	<a href="#">Edit</a>	<a href="#">Delete</a>

Login : 2004/03/05 User : admin

Start Local intranet 3:35 PM

# Map treatments

Diabetic Retinopathy Reading and Grading Centre - View Treatment - Microsoft Internet Explorer

File Edit View Favorites Tools Help

**DRAGON**  
Diabetic Retinopathy Assessment & Grading Over Network

Cases Reports Search Admin Logout

Admin Manage Treatment -> View Treatment Add

Treatment Name	Treatment Desc	Default Checked	Type	Edit	Delete
Focal Laser	Focal Laser	False	Eye specific	<a href="#">Edit</a>	<a href="#">Delete</a>
Pen Retinal Laser	Pen Retinal Laser	False	Eye specific	<a href="#">Edit</a>	<a href="#">Delete</a>
FFA	FFA Treatment	False	Eye specific	<a href="#">Edit</a>	<a href="#">Delete</a>
Optimize Medical Therapy of Glucose, BP, Lipids	Optimised Medical Therapy	True	Common	<a href="#">Edit</a>	<a href="#">Delete</a>
Refer to an Ophthalmologist for Tertiary Care	Refer to an Ophthalmologist for tertiary care	True	Common	<a href="#">Edit</a>	<a href="#">Delete</a>
Consider PRP for Patients with Type 2 DM	Consider PRP for patients with type 2DM	False	Eye specific	<a href="#">Edit</a>	<a href="#">Delete</a>
IHD Nephropathy	IHD Nephropathy	False	Eye specific	<a href="#">Edit</a>	<a href="#">Delete</a>
Urgent: Refer to an Ophthalmologist for tertiary care with out delay	Urgent Refer to an Ophthalmologist for tertiary care without delay	True	Common	<a href="#">Edit</a>	<a href="#">Delete</a>
Complete bed rest, Restricted physical activity.	Complete bed rest Restricted physical activity	True	Common	<a href="#">Edit</a>	<a href="#">Delete</a>
Surgery	Surgery	True	Eye specific	<a href="#">Edit</a>	<a href="#">Delete</a>
FFA	FFA Treatment	False	Eye specific	<a href="#">Edit</a>	<a href="#">Delete</a>

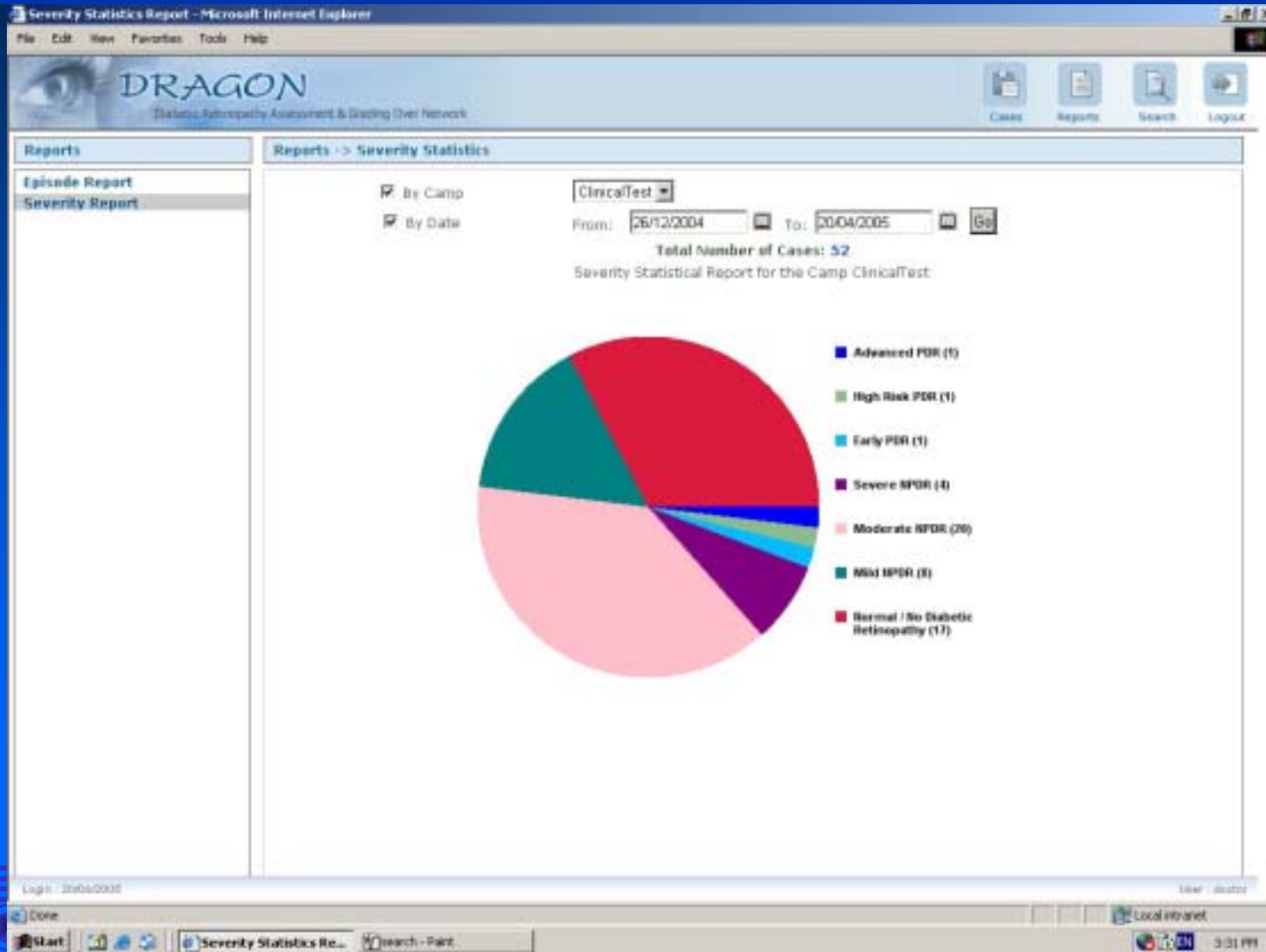
Login: 2004/0008 User: Admin

Done Local intranet

Start Diabetic Retinopathy ... User - Paint 2:34 PM

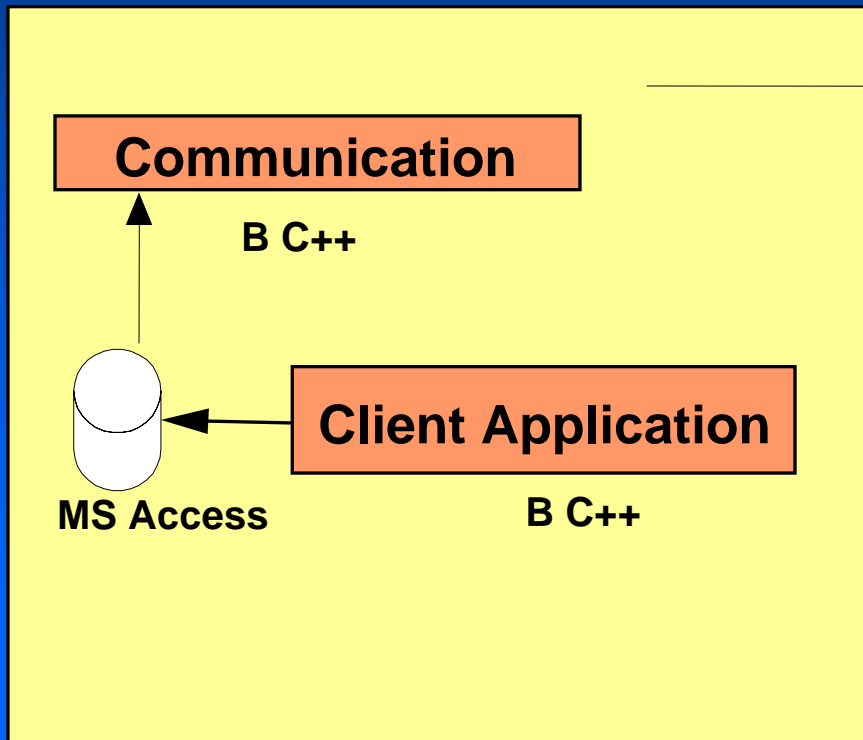


# We can generate reports about the status of cases and the diagnoses

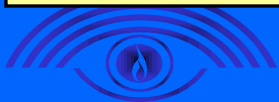
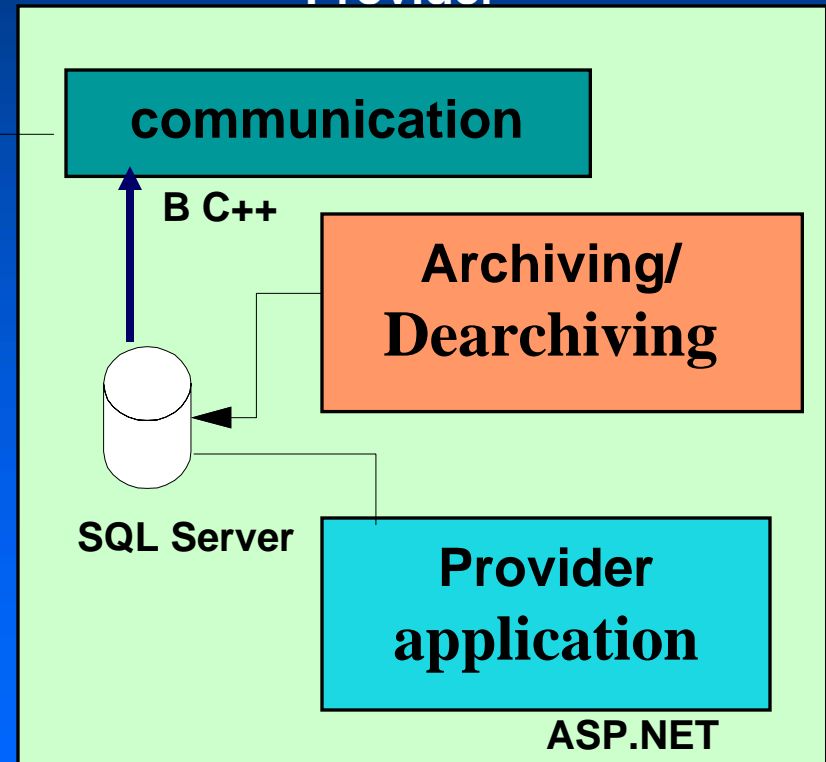


# DRAGON

## Client



## Provider





VSAT



Images Captured in the mobile screening van



Sent to the Reading center through VSAT



Images Read and Graded using specialised software Called DRAGON (Dibabetic Retinopathy Assesment and Grading Over Network)



Report regarding the severity level and further action is

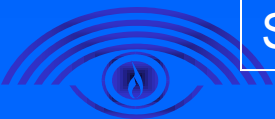


Sent to the mobile van VSAT

## Mobile Screening Van

Process takes 1 hour

Pt. counselled regarding further action suggested



# SN-TM project



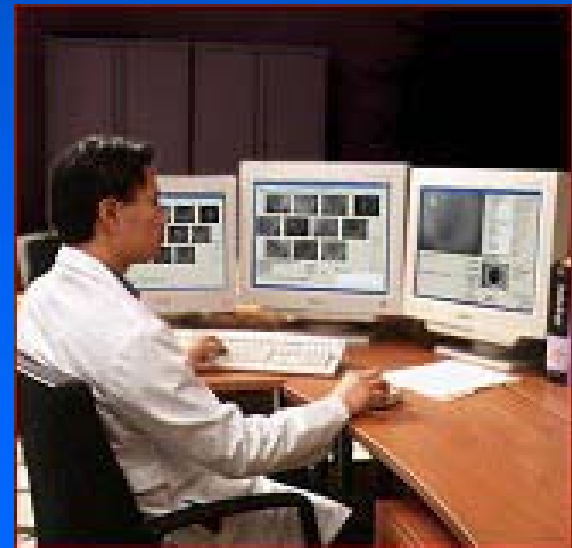
# Tele-ophthalmology Models elsewhere

## Wilmer - Digiscope

- Ensure early intervention to screen for diabetic retinopathy – empowers primary care physician

### Digiscope – Wilmer-EyeTel Innovation

- Images captured by Digiscope transmitted over Internet to the Reading & Grading Centre, Wilmer



# In Tertiary care

---

- Two Modes used in Consultation
  - Real time or Interactive Videoconferencing
  - Store & Forward





# In Tertiary Care



Experts at Madurai giving his opinion to a patient examined at a different hospital – Real Time over Videoconference





FarEndCamera



2400

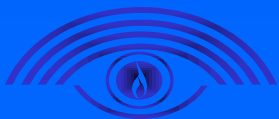
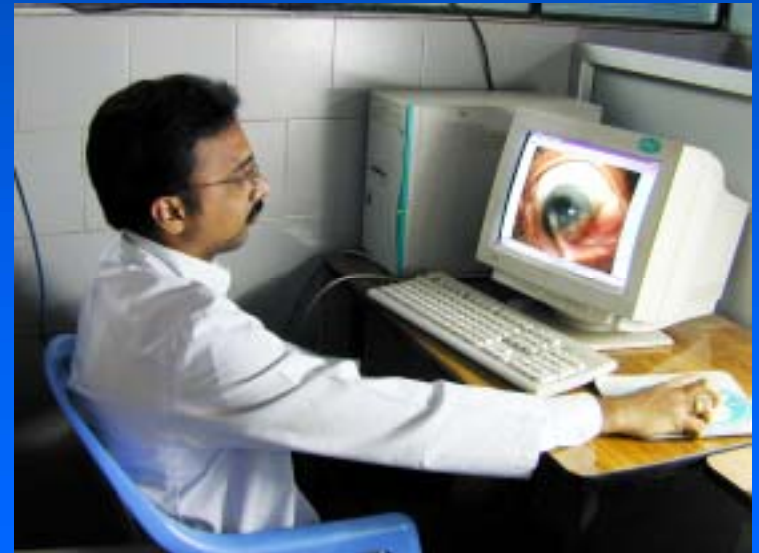
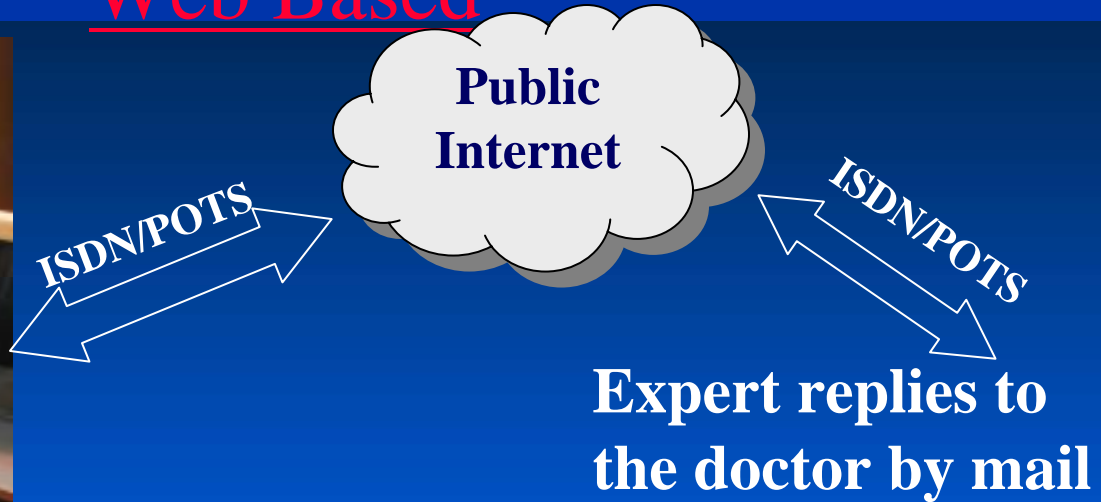
PHILIPS

# Store and forward technology

Web Based

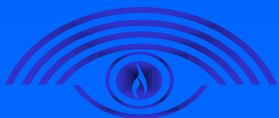


**Doctor sends  
patient information  
through mail**



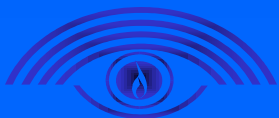
# Store & Forward Mode

- Compiled medical data is stored and transmitted to another site for review.
- Rate of transmission is slower, not done in an live interactive way
- A structured software to capture and maintain patient data for subsequent consultations / reference



# eyesTalk...a store & forward software...

- Developed here
- Allows general ophthalmologists to access speciality care
- Uses e-mail
- Client and Provider





MEENATCHIAMMAL P F / 58 123191

Patient Details

Episodes : 7/18/2006 12:27:28 PM

Casesheet



Attach images



Close episode



Edit casesheet



Print casesheet



Expand casesheet

General Informations

Presenting Complaint Def Vn BE 1 Month Known as DM 1 Yr on Rx,

Visual Acuity Unit: Snellen(Meters)

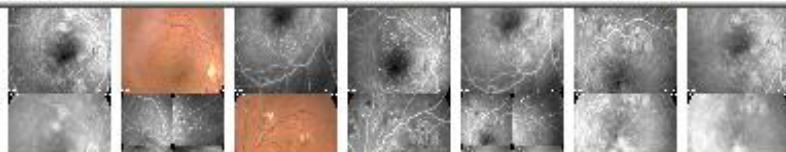
Vision	Right Eye		Left Eye	
	Distant	Near	Distant	Near
Un-Aided	6/36	---	6/60	---
Aided	---	---	---	---
Pinhole	---	---	---	---

Intra Ocular Pressure

	Right Eye	Left Eye
Schiotz	12.2 mm Hg	12.2 mm Hg
Applanation	mm Hg	mm Hg
Non-Contact	mm Hg	mm Hg

Signs

	Right Eye	Left Eye
Lid and Adnexa	NORMAL	NORMAL
Conjunctiva	NORMAL	NORMAL
Cornea	CLEAR	CLEAR



Messages



Compose message



Sort up



Sort down



Print messages

Provider: All

**AEH Madurai : (7/18/2006 12:40)**

RE-MOD NPDR LE-SEVERE NPDR WITH MACULAR ISCHAEMIA ADV-EVERY 3 MONTHS FOLLOW UP

**Dr.Kim , sankrish : (7/18/2006 12:31)**

Kindly expert your opinion and management.





Status :Sent | Current Owner :Retina | Owner Since :7/13/2006 4:49:00 PM

**BALASUBRAMANIAN R M/66**  
 247695

[Print CaseSheet](#)
[Print Comments](#)
[Patient Details](#)
**General Informations**

Presenting Complaint	Pt come for Routine checkup.
Systemic Illness/History	Known as DM 25 Yrs on Rx.

**Visual Acuity** Unit: Snellen(Meters)

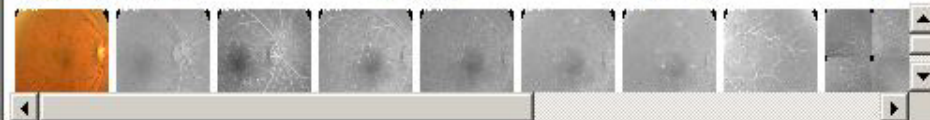
Vision	Right Eye		Left Eye	
	Distant	Near	Distant	Near
Un-Aided	6/12	---	6/12	---
Aided	---	---	---	---
Pinhole	6/6		6/6	

**Intra Ocular Pressure**

	Right Eye	Left Eye
Schiotz	mm Hg	mm Hg
Applanation	mm Hg	mm Hg
Non-Contact	20 mm Hg	14 mm Hg

**Signs**

	Right Eye	Left Eye
Lid and Adnexa	Normal	Normal


**Retina , AEH Madurai ( 7/13/2006 4:48:03 PM )**

BE are suggestive of Moderate NPDR and needs observation only.  
 Review him after 4 months.  
 Kim

**Dr.Datta , AEHTHENI ( 7/8/2006 9:08:57 AM )**

Kindly expert your opinion and management.



## Client Hospital

## AEH Madurai

## Experts

Patient History  
Case Sheet  
Ophthalmic Images

Second Opinion

Expert Opinion

Client

FTP

Provider

Application and  
Communication

VC++

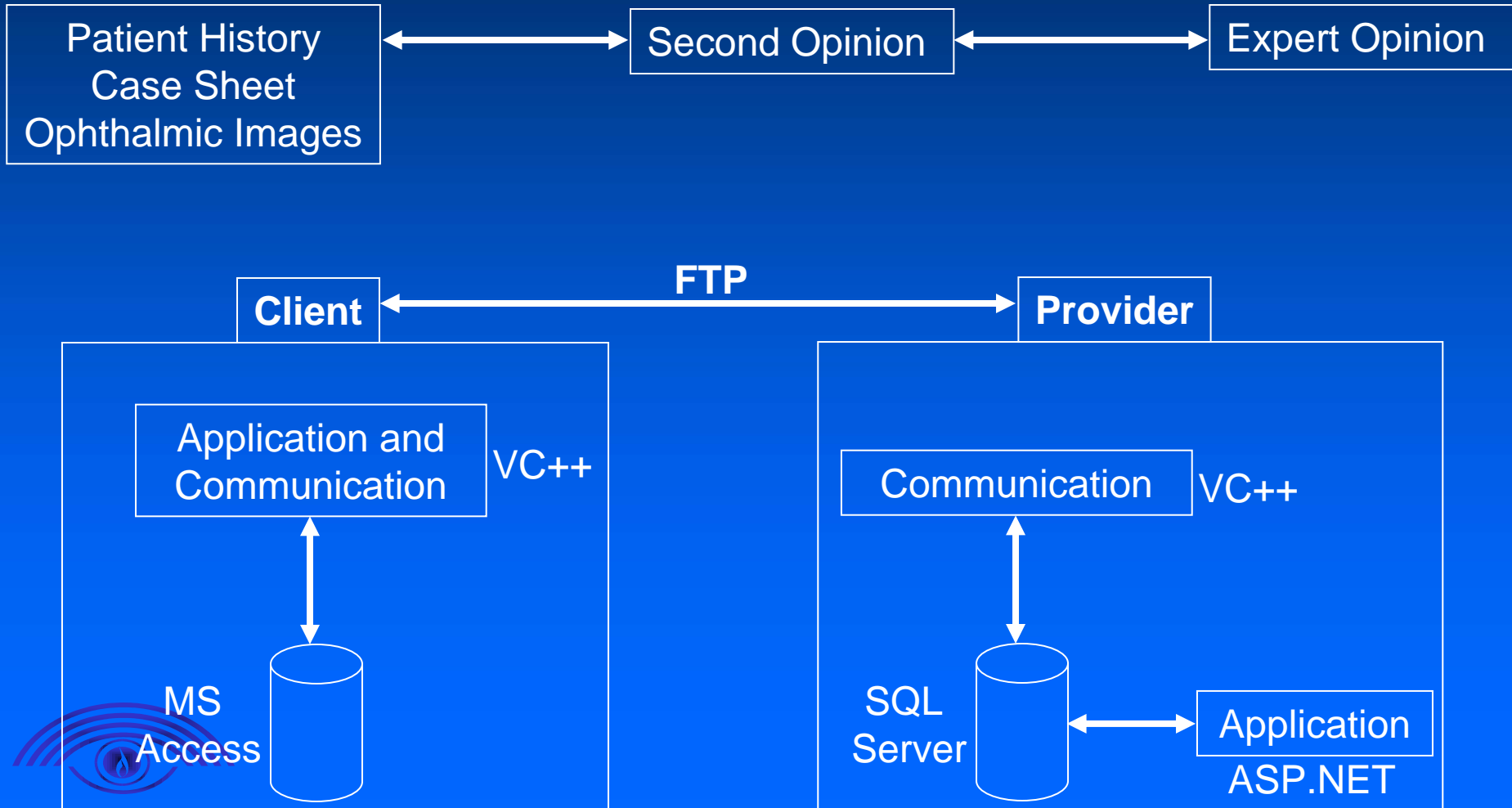
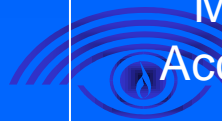
MS  
Access

Communication

VC++

SQL  
Server

Application  
ASP.NET



# eyestalk

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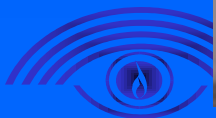
- Becomes a learning tool
- Empowers primary care ophthalmologists to manage all cases
- Easy accessibility for speciality care



# In Tele - education



# Tele-education – 5 hospitals in the weekly Grand rounds

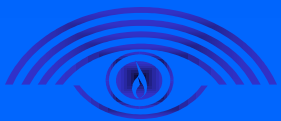


# Aravind - Wilmer Grand Rounds

...distance does not matter



Wilmer Eye Institute,  
Johns Hopkins University,  
Baltimore,  
USA



# Tele-education

The screenshot shows a Windows Internet Explorer browser window displaying the Sankara Nethralaya e-learning portal. The address bar shows the URL: <http://www.ekalavya.org/sntechnologies/startup/index.asp>. The page features a blue header with the Sankara Nethralaya logo and the Ekalavya logo. Below the header, there is a navigation menu with links for "Home", "Feedback", and "Contact Us". The main content area is titled "Towards Excellence" and includes a "Welcome to the e-learning portal of Sankara Nethralaya" message. A sidebar on the left lists categories such as "Ophthalmology", "Optometry", "Ophthalmic Nursing", "Medical Lab Technology", and "General". A sidebar on the right contains a "Connect" section with links for "Ask the experts" and "Discussion Forum", and an "E-Learning Poll" section with options: "I agree to this", "I disagree", "Not aware", and "I dont think so". The bottom of the browser window shows the Windows taskbar with various open applications and the system clock displaying 12:33 PM.

Ophthalmology, E-Learning portal, Distance Learning, Grand Rounds, CME, Eye, Sankara Nethralaya - Windows Internet Explorer

<http://www.ekalavya.org/sntechnologies/startup/index.asp>

File Edit View Favorites Tools Help

Google - Search

Ophthalmology, E-Learning portal, Distance Learning,...

Sankara Nethralaya

Do you want to stay updated and always ahead?

ekalavya.org

Vision for the Millenium

New User? Register

ekalavya Login

User Name

Password

GO

Feedback Contact Us

Home

Categories

- Ophthalmology
- Optometry
- Ophthalmic Nursing
- Medical Lab Technolo
- General

**Towards Excellence**

Welcome to the e-learning portal of Sankara Nethralaya

Connect

- Ask the experts
- Discussion Forum

E-Learning Poll

E-Learning is different from traditional learning

- I agree to this
- I disagree
- Not aware
- I dont think so

Vote

This portal addresses a variety of people involved in the delivery of eye care. Programs have been custom made for each speciality concerned. For example: Ophthalmology, Optometry, Ophthalmic Nursing etc.

There are structured courses in various subjects. Grand rounds are an important aspect where in once in 7-15 days a new case will be posted on the web along with a discussion. Readers are encouraged to participate in the discussions.

The course content is written by experts in each field and contains practical information that is not present in standard text books. The subject is presented in easy to read format supported by pictures and animations

Done

start

Inbox - Micro...

Ekalavya.org...

2 Windows ...

2 Microsoft ...

Ophthalmolo...

Internet

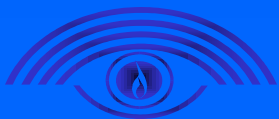
100%

12:33 PM



# In conclusion...

- Telemedicine
  - takes speciality care to the unreached
  - empowers local community/professionals to access quality care and skills & knowledge
  - Sharing knowledge and expertise
  - saves time and money



A photograph of a sun-dappled forest path lined with tall, leafy trees. The path leads into the distance, and the overall atmosphere is peaceful and natural. The text 'Thank You' is overlaid in the center-right of the image.

**Thank You**