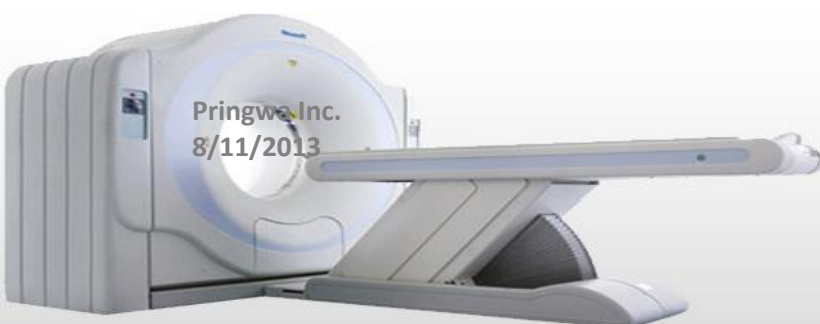




# iRadiology v1.0

:: Project Brief ::



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# 1. INTRODUCTION

iRadiology stands for Internet Radiology which is just a nomenclature meaning using solutions enabled by internet technology to solve basic radiology request and reporting problems. The iRadiology Project involves a transformation of the division's current predominantly paper-based clinical documentation system to a Web-enabled solution that is better aligned with the aim of improving quality of care with increased efficiency and accuracy.

iRadiology is developed line with the European Commission approved *MEDDEV 2.1/6* guideline for the manufacture of standalone medical software and as such can be considered a RIS. A RIS (Radiological Information System) is a software based system used at radiology departments to store, process or transfer radiological images and patient information. The system normally includes functions for patient identity, scheduling, examination results and imaging identification details.

The iRadiology project was first developed for the Radiology Department of Ahmadu Bello University, Zaria on the need for a patient information management system. In fact this version is coined based on the manual work system of patients' records in the department.

Preliminary assessment of the activities in the department favoured the development of this software. Worthy of note is the constant power availability in the department due to the nature of work been carried out.

## 1.1 iRadiology Objectives

- ✚ To facilitate efficient and effective information capture, representation, and navigation using the application, as well as report generation, auditing, user performance tracking and user access control.
- ✚ To architect and implement a prototype visualization application that summarizes and documents a radiology request, patient's Diagnosis (es), Treatment(s), and Response(s) in chronological order not forgetting patients' appointment, alert and report printing systems.

## 1.2 System Users

This model tailored from ABU, Zaria work system has four categorises of users.

- ✚ Administrator
- ✚ Receptionists
- ✚ Doctors (Radiologist)
- ✚ Typists

## 1.3 Scope

iRadiology v1.0 is NOT a conventional application that can be used as required. It needs to be customized to suit the often unique work systems of any Health institution in need of it with additional testing and review by the end users and IT professionals. This version includes the following modules.

- ✚ Login – User authentication and tracking \*all users\*
- ✚ Search for Patient Records \*all users\*
- ✚ Entering/editing Patients' personal records \*receptionist and admin\*

- ✚ Creating a radiology request \*receptionist and admin\*
- ✚ Appointment System \*receptionist and admin\*
- ✚ Entering radiology result \*doctor, typist and admin\*
- ✚ Generating and Printing Radiology Report \*all users\*
- ✚ Activation and Deactivation of users \*admin\*
- ✚ Patients reports, charts and analysis \*admin and doctors\*
- ✚ Logout

These features included in iRadiology v1.0 may be subject to further enhancements and/or improvements in subsequent versions.

## 1.4 Document Overview

This document describes the iRadiology project and the approach taken to deliver iRadiology v1.0. It begins with an introduction of the project, its users and scope

The “Software Overview” section documents the business need for iRadiology and the proposed solution that iRadiology offers. It gives a brief overview of the features included in iRadiology v1.0, and the deliverables iRadiology Project.

The “Managerial Process” details the work system used for modelling this application, risk management techniques, and the recommendation for the future of the application.

Finally, the executive summary (reviews the software) and contact information.

## 2. Software Overview

### 2.1 Current Process and its Limitations

Currently, in the Department of Radiology in Ahmadu Bello University for instance, patients are usually referred to the radiology department from any of the clinics/wards(GOPD, A&E etc.) in the hospital bearing request form(s) for various levels of radiology tests(Ultrasound Scan, X-Ray, MRI-Scan, Fluoroscopy etc. ). The receptionist welcomes the patient, collects and manually records the information on the request card into a 'Large Book of Records', looks up the calendar and estimates an appropriate appointment date, write it out and gives it to the patient. On the appointed day, the patients come and join a long queue of other patients awaiting the doctors' appointment. See the radiologist and probably join another queue waiting to collect the result if it is due that day.

The main drawbacks from this process are:

- ✚ *Time Wastage:* Many patients spend more than half a work day on long queues trying to see the radiologist for a test/scan which would only take a couple of minutes.
- ✚ *Paper-based system makes discussion and communication about patient care difficult:* Retrieval of patient's information becomes difficult since a paper file cannot be accessed remotely. Understanding a patient's condition involves shuffling through the various and sometimes voluminous sheets of paper in the file and hence it is difficult to get a clear overview of the patient's condition and history.
- ✚ *Inefficient process for synthesis and analysis of patient information:* A system that stores information in a single, inaccessible paper file has inherent inefficiencies which can be addressed by making the system paperless. Electronic systems are easier to maintain, update and access and hence more efficient than paper-based systems.
- ✚ *Lack of centralized data repository:* Since the patient's information is not stored in a central location and accessible remotely it introduces the danger of inconsistencies and inaccuracies between multiple records.

### 2.2 The iRadiology Solution and its Benefits

The iRadiology Project is designed to introduce a higher level of efficiency into the current process of processing patients' information and reports. Through this new process the patients request information is entered into iRadiology (by receptionist or admin on login to the system), iRadiology process and stores the information for easy retrieval and documentation. It automatically generates appointment calendars with appointment time and dates and consultant radiologist to see at the appointed time.

The Doctors (radiologists) upon login to iRadiology sees a chart of the number of appointments for the week, the patients appointments slatted for the day and he/she can view all request card information and history of all previous radiology appointments and results of any patient. The patient search module is also active for the doctors. After the test/scans is done the radiologist can ask a typist to or

enter the result himself into iRadiology and the result status is then set to complete and can be printed by any user and signed by that doctor. The radiologists have access to reports and some setup options.

The typist in iRadiology is put to help the radiologist in typing in the test result and conclusion for the radiologist to proof read, confirm and subsequent signing and print out. This user-group (typist) is optional in the process flow as radiologists who are less busy can type in the results, conclusions and even print out and sign the report themselves.

The iRadiology administrator activates the other user groups. She/he can register users as required, and can perform almost any user task on the system. The admin has access to all reports, charts and settings in iRadiology.

The benefits of iRadiology cannot be over emphasized. It follows from the general benefits of using computers (i.e. information-system) to manage information when compared to the manual process (i.e. work-system) of doing same. Some are:

- ✚ *Less time Wastage:* Since most of the process of information retrieval, and reporting is done by the computer, less time and paper is wasted.
- ✚ *Accessible and Updatable:* Update and maintenance of accurate and integrated patient information. Easy access to multiple sources, types and sources of patient information.
- ✚ *Centralized Data:* A centralized data repository allows for patient information to be retrieved from one location, limiting the need to consult other repositories. In addition, a centralized database allows for a one-step correction process in correcting data as needed.
- ✚ *Visual Representation, Reporting and Charts:* Facilitates comprehension and discussion through an intuitive and dynamic graphical representation, reports and charts.

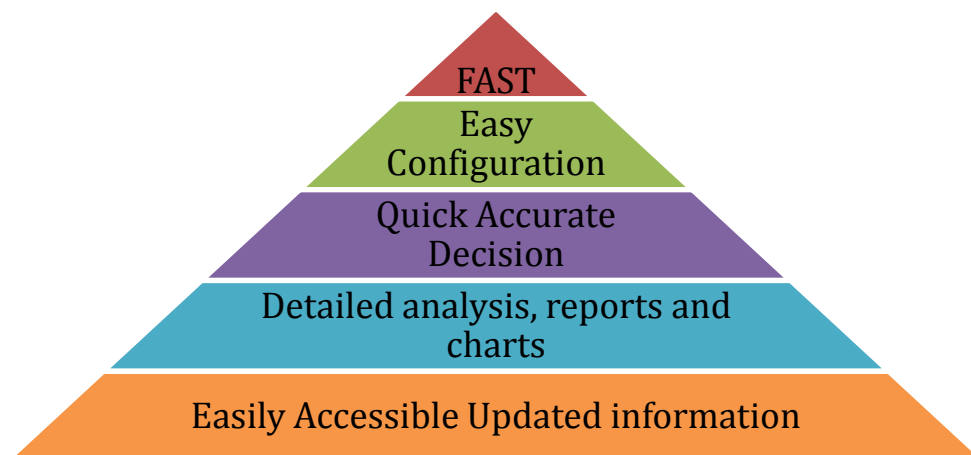


Figure 1: Benefits of iRadiology

## 2.3 iRadiology v1.0 Features

### 2.3.1 iRadiology Home

The iRadiology Home represents the home page of the entire application or typical look of a user's home page upon login. Below is look at a sample interface for Ahmadu Bello University Teaching hospital, Zaria.

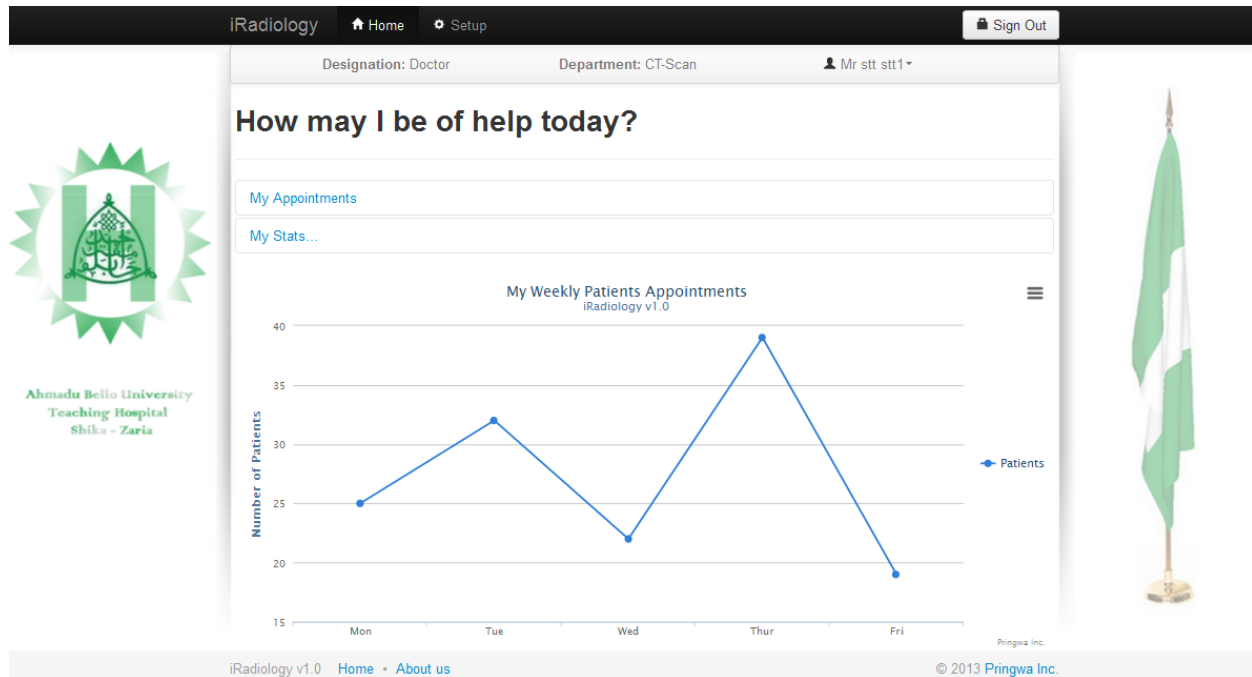


Figure 1: Sample Home Page

### 2.3.2 Sign Up

Sign Up button is located on the top right corner of the iRadiology project.

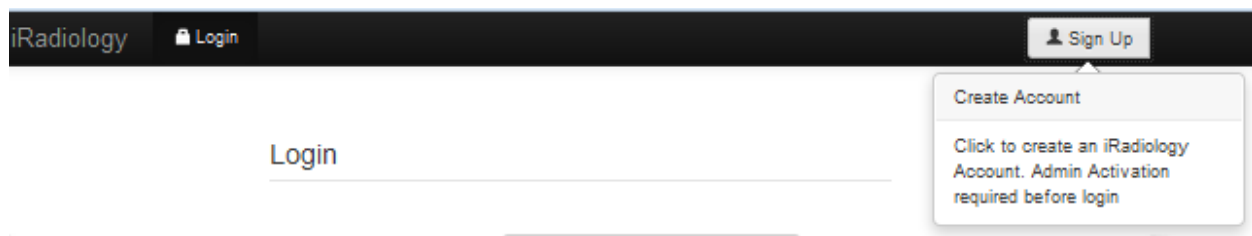
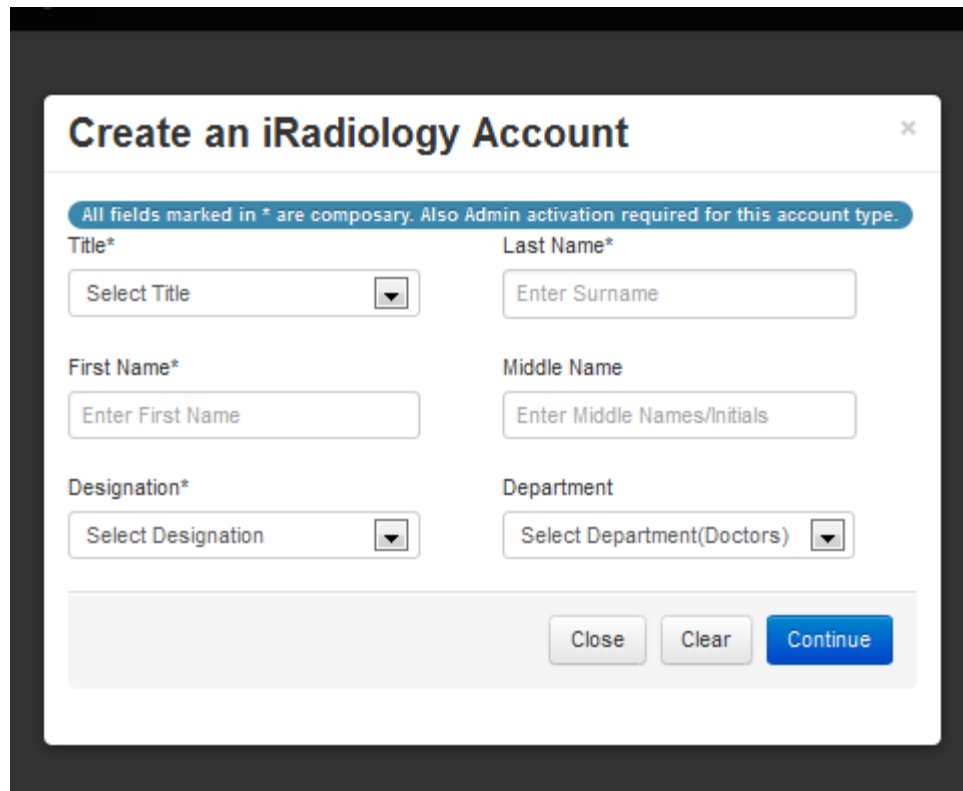


Figure 2: Sign Up Button

A form pops up for a new user to register on clicking the button.



**Create an iRadiology Account** ×

All fields marked in \* are compulsory. Also Admin activation required for this account type.

Title\*  Last Name\*

First Name\*  Middle Name

Designation\*  Department

Figure 3: Sign Up Form

On continuation a security page displays where you choose a unique username and password. All goes well a user will be successfully registered awaiting admin activation.

[Continue Registration](#)

## Security Details

Choose a unique Username and a password, confirm and submit.  
Admin would need to activate your account before you can login though.

Username

Password

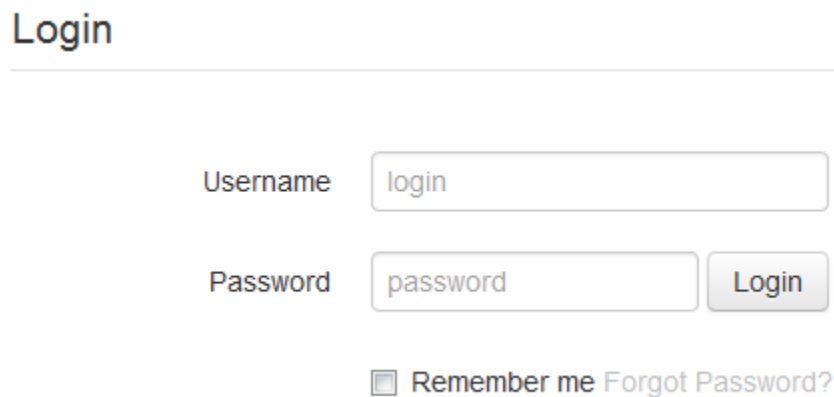
Confirm password



Figure 4: Signup Security Details

### 2.3.3 Login

Users will be required to log into iRadiology to be permitted to access any of the modules in the application. Each user chooses a unique *User Name* and a *Password* and a *User Group* upon registration but needs to be activated by the administrator. A screen shot of the *Login* user interface is shown as Figure 2.



Login

Username login

Password password Login

☐ Remember me [Forgot Password?](#)

Figure 5: Login

Based on their *User Group (Role)*, users are redirected accordingly.

### 2.3.4 Patient Search

Patient search is a module that is available to all users of the iRadiology v1.0. The reason behind the search may differ though. The typist search for patient he has been asked to enter result information for; the receptionist search to check the existence of the patient so as to enter radiology request against that patient or register a new patient, view history of appointments, or update personal information of the patient. The radiologist carry out search to view card information, history or writing out a report. The admin may search for any of the previously mentioned reasons and more. Sample search by a radiologist is captured below.

iRadiology
Home
Setup
Sign Out

Designation: Receptionist
Mr Musa Audu

## How can I be of help today?

Search Patients

Find Patient

Search patient using either their Surname, Other Names or Hospital Number. Click 'Proceed' to complete radiology request information and schedule he/her for a doctor's appointment. OR click the patient id to adjust some personal informations about the patient.

Click 'Add New' to register a new patient in the system if the patient is not in the system

Patient's No.	Surname	Other Names	Age	Hospital No.	Occupation	Sex	
19	Hanks	Fozzy	54	3245321	Lecturer	Male	<a href="#">Proceed</a>

[Add New](#)

Figure 6: Patient Search by Receptionist

### 2.3.5 Patient Registration

The receptionist has this role. The registration process for a new patient is in 3 steps: Entering Personal information, creating a Radiology Request, and Booking Appointment. For patients already in iRadiology only the last two steps are required. These steps are captured below:

Fill this form to register a new patient. Proceed to complete Radiology Request information. All fields are Required!

Surname	<input type="text" value="Giwa"/>	Other Names	<input type="text" value="Ahmad"/>
Sex	<input type="text" value="Male"/>	Occupation	<input type="text" value="Student"/>
Age	<input type="text" value="25"/>	Hospital No.	<input type="text" value="3243455"/>

Figure 7: Patient Registration.

iRadiology

[Home](#)

[Request Information](#)

[Setup](#)

[Sign Out](#)

Designation: Receptionist

Mr Musa Audu

## Complete Radiology Request Information

Consultant i/c	<input type="text" value="Dr. Suke Hassan"/>	L.M.P.	<input type="text" value="10/10/2013"/>
Clinic	<input type="text" value="GOPD"/>	Amount	<input type="text" value="1200"/>
Provisional Diagnosis	<input type="text" value="Simple multinodula goiter"/>	Clinical Notes	<input type="text" value="4 yrs and half out cheek swelling. No porous symptoms"/>
Department	<input type="text" value="Ultrasound"/>	Date	<input type="text" value="28/10/2013"/>
Sub-Dept.	<input type="text" value="Thyroid"/>		

Continue

Cancel

Figure 8: Request Form

## Schedule Appointment for Giwa Ahmad ID: 23-30

Date

Monday, November 04, 2013

Time

10:00am

Doctor

Fati Atta

Book Appointment

### Calendar Help

<<
<
October
2013
>
>>

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 9:00 AM - <div>\$\$\$ \$\$\$1</div>	2	3	4	5
6	7	8	9	10	11	12
13	14 9:00 AM - <div>Fati Atta</div>	15 8:00 AM - <div>Fati Atta</div>	16	17 8:00 AM - <div>\$\$\$ \$\$\$1</div>	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Figure 9: Scheduling Appointment

### 2.3.6 Patient Information Review

This deals with how the different users of the system handle patients' information daily. For the receptionists, besides entering patients' information, they are bothered with handling patients with appointment scheduled for that day. For the radiologists, they can review information of all the patients that are scheduled to see them. Below is what the receptionist and radiologist patient review looks like.

View Today's Appointments

Today's Appointments

Patients slated to see the Doctors Today! Use Department and Patient's No. controls to filter.

Department

Select Department

Patient No.

-Numbers Only Pls-

Search

Total Number of Patients: 15

Time	Patient No.	Names	Sex	Doctor	Status
8:00 AM	2-8	aab aab2	Male	Mr stt stt1	Pending
8:00 AM	3-2	Anthony Simon	Male	Dr sss sss1	Pending
8:00 AM	3-27	Anthony Simon	Male	Dr sss sss1	Pending
8:00 AM	8-9	Trisha Musa	Male	Mrs sts sts1	Pending
8:00 AM	13-7	Queen Amina	Female	Mrs sts sts1	Pending
8:00 AM	13-8	Queen Amina	Female	Mr stt stt1	Pending
8:00 AM	15-4	Abraham Simon	Male	Mr stt stt1	Pending
8:00 AM	15-12	Abraham Simon	Male	Mr stt stt1	Review
9:00 AM	5-14	Ene Tina	Female	Miss sst jdscv	Pending

Figure 10: Receptionist Appointment Template

## How may I be of help today?

My Appointments

My Patients Today

Total Appointments: 5

Status	Appointment Time	Surname	Other Names	Age	Sex	Occupation	
Pending	8:00 AM	Abraham	Simon	26	Male	Lecturer	<a href="#">Write Report</a>
Pending	8:00 AM	aab	aab2	22	Male	Student	<a href="#">Write Report</a>
Pending	8:00 AM	Queen	Amina	69	Female	Student	<a href="#">Write Report</a>
Review	8:00 AM	Abraham	Simon	26	Male	Lecturer	<a href="#">Write Report</a>
Pending	9:00 AM	Queen	Amina	69	Female	Student	<a href="#">Write Report</a>

Figure 11: Radiologist Appointment Template

All the iRadiology users apart from the typists can view Complete Patient Card Information on a slate.

**Complete Patient Card Information**

[Print Radiology Report](#)


<b>Patient Number</b>	23-30	<b>Status</b>	Pending
<b>Department</b>	Ultrasound	<b>Sub Department</b>	Thyroid
<b>Surname</b>	Giwa	<b>Other Names</b>	Ahmad
<b>Age</b>	25	<b>Sex</b>	Male
<b>Occupation</b>	Student	<b>L M P &amp; Clinic/Ward</b>	10/10/2013 GOPD
<b>Result</b>	The result of the test/scan goes here... I am just a sample text... Sorry!		
<b>Conclusion</b>	The conclusion of the scan/test goes here... I am just a sample text! Sorry Bro		
<b>Clinical Notes</b>	4 yrs and half cut cheek swelling. No porous symptoms		
<b>Provisional Diagnosis</b>	Simple multinodula goiter		
<b>Consultant I/C</b>	Dr. Suke Hassan	<b>Amount To Pay</b>	1,200.00

Close

Figure 12: Review Complete Patient Card

### 2.3.7 Patient Report

The Report contains the result of the test/scan carried out on the patient. For most referral cases, it is the document the patient takes to the ward/clinic where they came from, so as to receive adequate treatment. iRadiology automatically generates patient report. Below is a sample report.



## AHMADU BELLO UNIVERSITY TEACHING HOSPITAL, ZARIA

### Radiology Report

23-30-2013-10-28-USD

Surname	Giwa	Other Names	Ahmad
Age	25	Sex	Male
Hospital No	3243455	Ward/Clinic	GOPD

Thyroid      29/10/2013 1:02 PM

The result of the test/scan goes here... I am just a sample text... Sorry!

**Conclusion**    The conclusion of the scan/test goes here... I am just a sample text! Sorry Bro

---

Dr sss sss1

Printed by: Mr Musa Audu

Figure 13: Sample Patient Report

### 2.3.8 User Activation

The administrator of iRadiology is solely in charge of user activation.

## Change User Status X

---

Do you wish to Activate Daniel Dankwambe Tony?

Close
Continue

Prof Daniel Dankwambe Tony
Deact

Figure 14: User Activation



A registered user of iRadiology is said to *Exists* until the administrator activates that user. Active users can also be deactivated and vice versa from a list of registered users of the system as shown below.

[Registered Users](#)

**View Registered System Users**

Names(All) or Department(Doctors only)

Designation	Names	Status
Receptionist	Mrs Daniel Hanky Duff Okwori	Active
Typist	Mallam Daniel Jolly Shehu	Active
Receptionist	Mr Daniel Err Anthony	Exists
Doctor - CT-Scan	Prof Daniel Dankwambe Tony	Deactivated
Typist	Miss Daniels Yala Anthony	Active
Receptionist	Miss Elemelu Oyi Tony	Exists
Doctor - MRI	Prof Elemelu Oyi Adoga	Active

Figure 15: System Users

### 2.3.9 System Settings

This module handles the setup options for the master records (i.e. records that don't change easily) of iRadiology. Some of these records are: the departments in the Radiology Section of the hospital, body parts (sub-departments), standard test conclusions for statistical purposes (e.g. Normal Lungs Position, Has Breast Cancer etc.), Wards/Clinics in the hospital from which patient are usually referred to Radiology department, amongst others. Below is a sample setting for Wards/Clinics.

**Add/Edit Clinic**

Clinic ID	Clinic	Delete?
1	<input type="text" value="GOPD"/>	<input type="checkbox"/>
2	<input type="text" value="A&amp;E"/>	<input type="checkbox"/>
	<input type="text" value="Orthopaedic"/>	
	<input type="text"/>	

Figure 16: System Setting

### 2.3.10 Charts and Reports

The analysis and charts are perhaps some of the strongest features of iRadiology v1.0. iRadiology v1.0 comes with in-built support for different chart types with data export to Microsoft Excel as required for analysis and research. These includes comparing patient distribution based on age grade, gender, diagnosis, daily turn-ups, returning patients etc. and also staff performances can be tracked and monitored. All charts can be printed, exported as images in different image formats or as PDF document. Below are some sample charts.

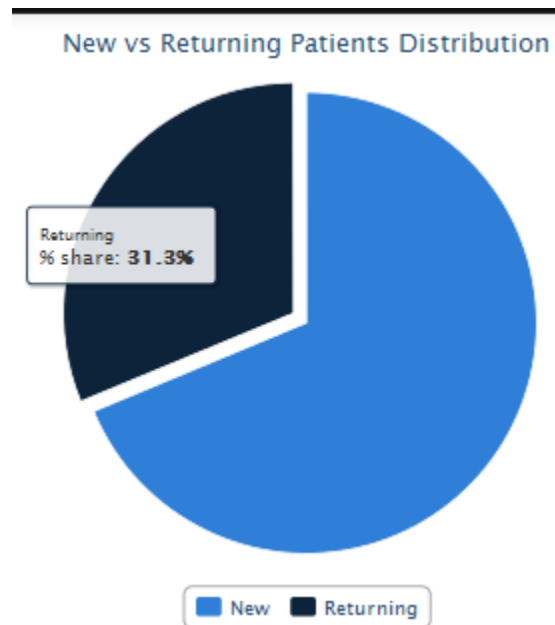


Figure 17: Comparing Returning and One-time Patients

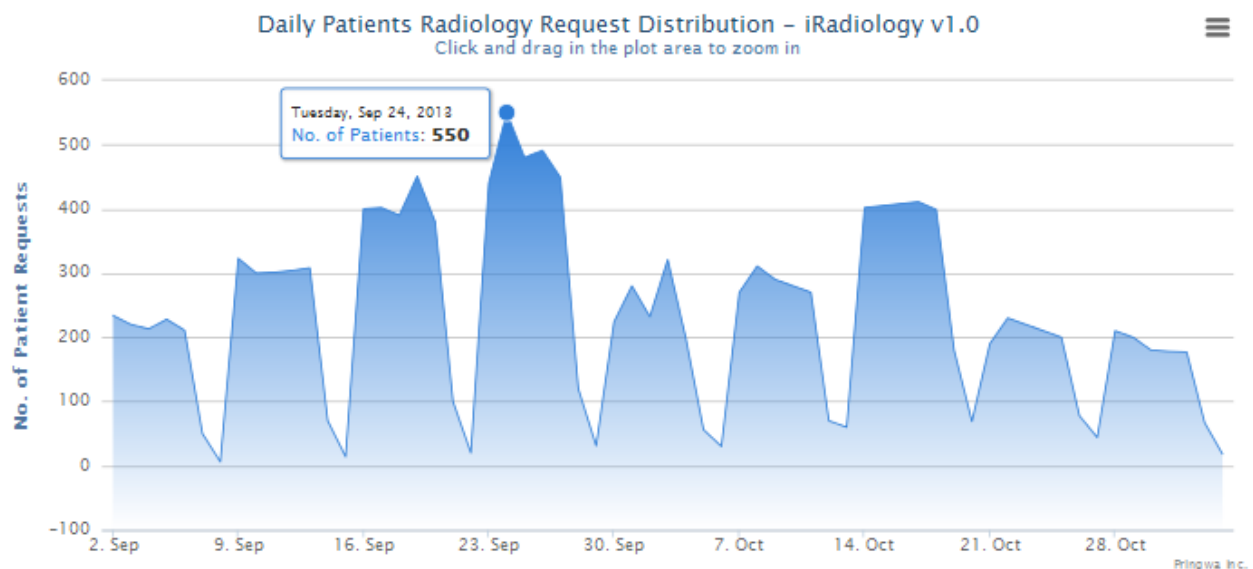


Figure 18: Daily Patients Request Distribution

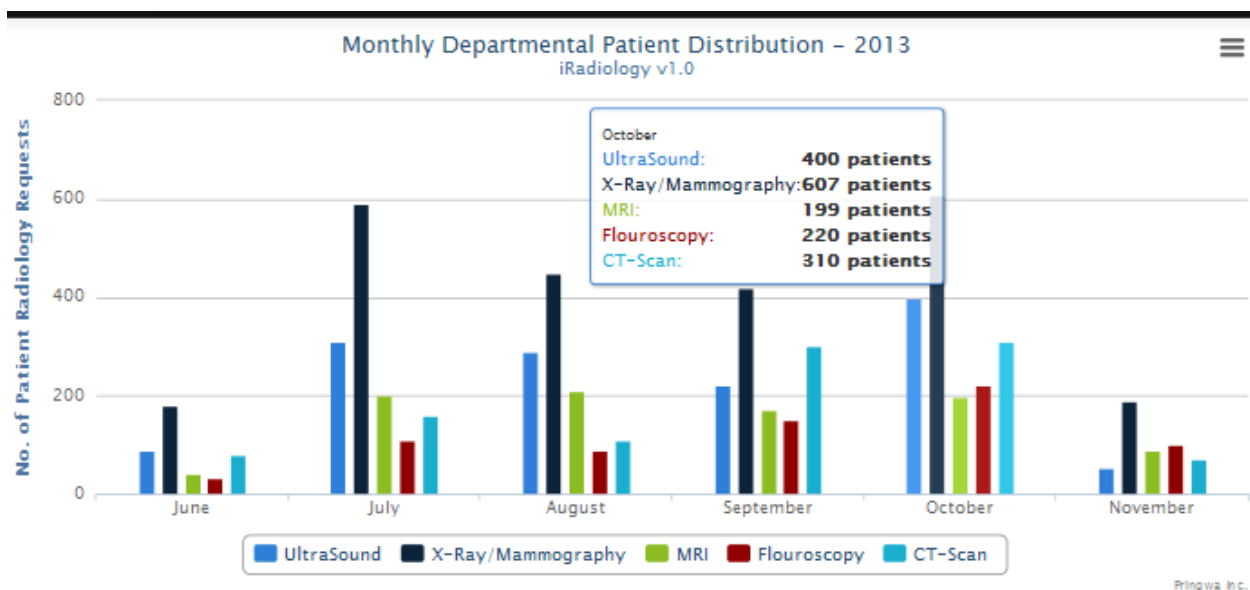


Figure 19: Comparing Monthly Request by Departments

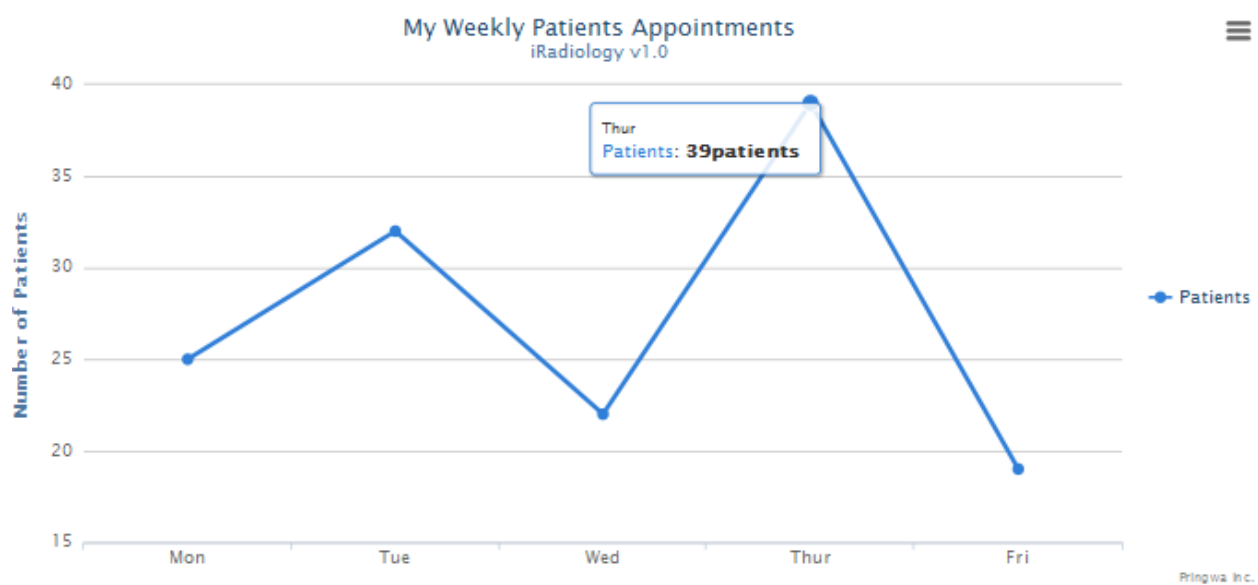


Figure 20: A Doctor's Weekly Patients Appointments

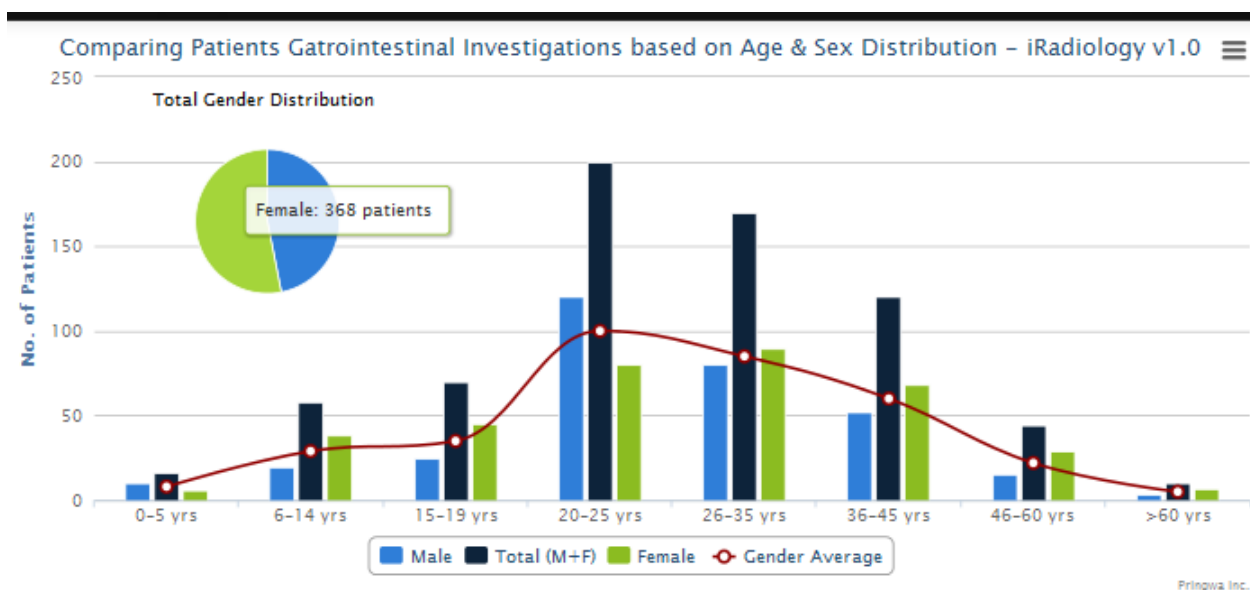


Figure 21: Combined Chart showing Age/Sex Distribution for a Test Condition

### 2.3.11 Others

iRadiology v1.0 has many more standalone systems and sub-modules not mentioned thus far. The whole application has the capability for expansion as required /needed. Some of these systems include: the *User Tracking System*, *Patient History Module*, *Change Password* and *Password Recovery Systems*, *'Remember me' System* and *Error Handling Systems*.

### 2.3.12 Logout

The *Logout* module allows the user to logout of iRadiology by ending the user's session. *Logout* does not have a separate user interface; instead it appears as a button on the top *right-hand Navigation Bar* of every page as shown below.

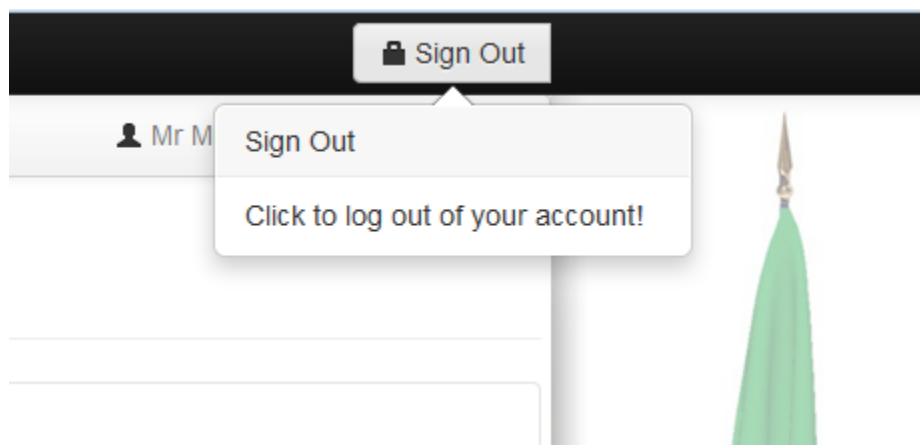


Figure 22: Sign Out button

## 2.4 iRadiology Technology

iRadiology, as stated earlier uses technology enabled by the Internet. The application can thus run on a network of systems (PCs and mobile devices) on a local network or via the internet. The application was developed using tested and trusted technology, with components used/developed by multinational IT firms. It is also Responsive, i.e. depending on the screen sizes of the devices used to view iRadiology, it adjusts accordingly.

### 2.4.1 Front-End

On the front-end, which consists of the part of the application the users interact with, iRadiology has multi-lingual configuration capability. The server side language can thus be customized to suit the need of any cooperation that uses it. The system can run on JAVA, .NET languages(C#, VB), PHP or ASP. The version developed for ABU Teaching Hospital (ABUTH), Zaria uses PHP as the server language since that is the official language used for most applications around the campus.

Extensive use of different JavaScript APIs helps ensure a clean interface with smooth user interaction. Components and framework from Twitter, BlackBerry, Yahoo and Google give the user an already familiar world class interface.

### 2.4.2 Back-End

iRadiology can store user information in a database that run on a trust database management systems. Any of SQL Server 2008 (and above), MySQL or ORACLE DBMS can be used as preferred. For ABUTH, MySQL was used for same reason explained previously.

## 2.5 Project Components.

iRadiology v1.0 come as package containing

- i. Program Executable
- ii. Supporting Programs Executable
- iii. Software Requirement Specification and Installation Guide
- iv. User Manual

All these are the deliverables after the customization has been carried out to suit the organization's needs. Tech support are available 24/7 are required especially for custom report generation.

## 3 Managerial Process

### 3.1 Work System Model

The work system model shows the manual work flow from which iRadiology v1.0 was developed from, in its simplest form. This may differ from one health institution to another. The software was developed with this in mind, i.e. depending on the workflow; it can be customized to work accordingly. In ABUTH Zaria, the work-flow is represented simply as shown below.

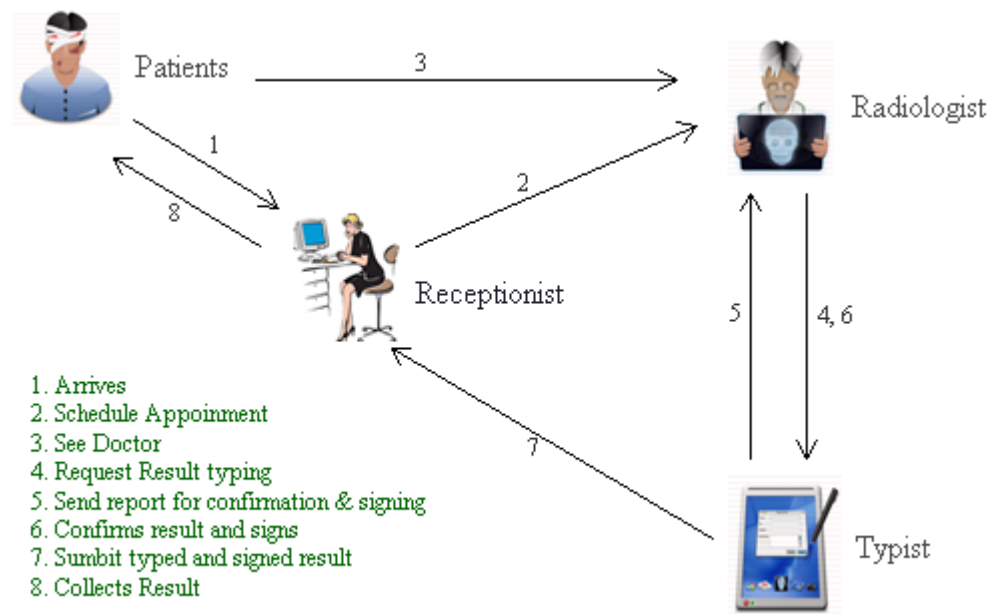


Figure 23: Work System

### 3.2 Risk Management

Medical Software/devices are mostly safety critical systems. This often affects the decision as to its use. In iRadiology risk management was a very important part of the software development life cycle. RIS often form the borderline case as whether to be classified as a medical device or not.

Risks with standalone software are often related to its performance as decision support. This means that the possible harm which is a consequence of a failure does not occur instantly, but instead as a series of actions due to problems with the information.

Patient safety and information safety (security) issues are often separated. This is not always entirely correct. Medical device requirements focus on safety for patients and individuals. The concept for information safety is defined in information safety standards and is intended to cover confidentiality, accuracy and access.

- Poor access can mean loss or delay of information and that the information has not been communicated or presented in a manner that makes sense for the intended user.

- Loss of accuracy can mean distortion, miscalculation or mix-up of information.
- The confidentiality requirement involves mandatory secrecy, protection against disclosure and assurance that the information only is made available for those who are qualified

iRadiology v1.0 though developed according to medical device standard of the EU, is NOT A MEDICAL DEVICE. This is why!

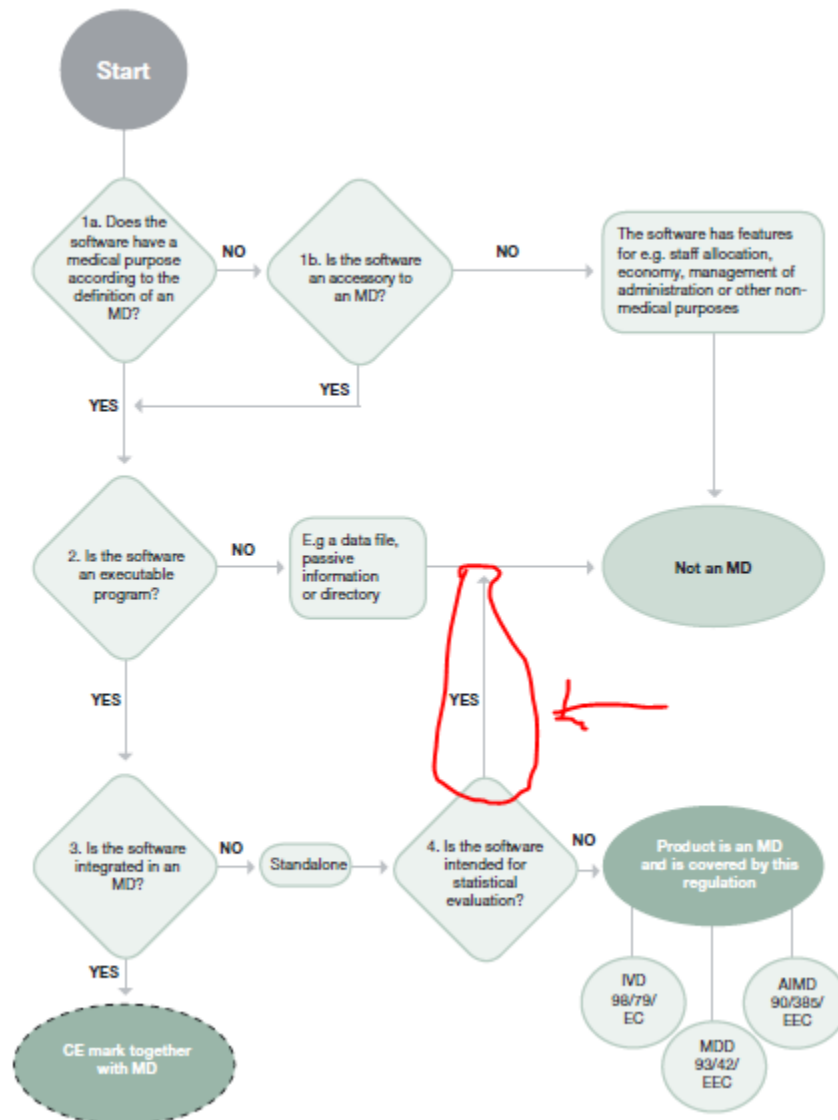


Figure 24: Medical Software Qualification Flow Chart

Subsequent versions might be considered a medical device, as imaging processing might be included and as such risk management become even a bigger business. This version was more concerned about statistical purposes primarily for research and information management.

### 3.3 The future

The extension capabilities of iRadiology v1.0 cannot be overemphasized. Interface with Picture Archive Communication System (PACS) or even its own PACS component with advance imaging technology is perhaps the most outstanding of these. Others include interactive documents, alert system running via the internet for patient/users text/fax/email alerts, its own mobile application, staff turn-around-time management system, and porting to other hospital software.



## 4 Executive Summary

This document is intended to give a brief overview of the software iRadiology for Health institutions. The contents are just highlights and not a full user guide. The entire charts show sample data only.

More information, discussions and technical presentation on the use of this application would be highly welcome upon request.

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