Dissertation Title

"Pre-Implementation phases during implementation of Apex EMR at a multispecialty Hospital"

A dissertation submitted in partial fulfillment of the requirements
For the award of

Post-Graduate Diploma in Health and Hospital Management

by

Priyanka Yadav
Roll No. PG/10/093

International Institute of Health Management Research
New Delhi-110075
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Under the guidance of

Mr. Pratik Parikh
Functional Head (Implementation)
21 Century Informatics

Prof. Anandhi Ramachandran
Prof. Indrajit Bhattacharya
Prof. T. Muthukumar
IIHMR, New Delhi

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A. Acknowledgement

I hereby take this opportunity to thank, Mr. Pratik Parikh, Functional head (Implementation), 21 Century Informatics and for their valuable guidance and advice.
They inspired me greatly to work in this project. Their willingness to motivate me contributed tremendously to my project.

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Finally, an honorable mention goes to my family and friends for their understanding and support on me in completing this project.

Thank You
Priyanka Yadav
PGDHHM,
IIHMR, New Delhi

Certificate of Internship Completion

Date: 31/04/2012

TO WHOM IT MAY CONCERN

This is to certify that Mr./Ms./Dr. _____ has successfully completed his 3 months internship in our Organization from February 02, 2012 to 02, 2012. During this intern he has worked on …….(task performed) under the guidance of me and my team at …….(organization). ……(any positive/negative comment)

We wish him/her good luck for his/her future assignments

(Signature)

_____(Name)

_____Designation

Certificate of Approval

The following dissertation titled **"Pre-Implementation phases during implementation of Apex EMR at a multispecialty Hospital"** is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of **Post-Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation

Name	Signature
_____	_____
_____	_____
_____	_____

Certificate from Dissertation Advisory Committee

This is to certify that **Ms. Priyanka Yadav,** a graduate student of the **Post- Graduate Diploma in Health and Hospital Management**, has worked under our guidance and supervision. She is submitting this dissertation titled "**"Pre-Implementation phases during implementation of Apex EMR at a multispecialty Hospital"** in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital Management**.

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

T. Muthu Kumar
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A. Abstract

"Pre-Implementation phases during implementation of Apex EMR at a multispecialty Hospital"

By

Priyanka Yadav

Research shows that roughly 73% of all EMR implementations fail. Experts give numerous reasons that may contribute to this failure, three of which specifically stand out as greatest contributing risk factors when converting physician offices to electronic medical record (EMR) systems: The first factor in EMR risk is the **style of implementation**. Many vendors try to cram the practice-changing techniques into a very short period of time - often too short for proper adoption and full understanding of how the new system works best in each unique practice environment.

The second factor in EMR risk is **lack of useful clinical content in its design**, which slows down and frustrates the user, leading them to abandon the EMR all together. The right EMR can actually save time and increase the accuracy of patient record documentation. An EMR that is customized around the unique needs of the specialty where it is supposed to be implemented can be proven as the successful and sophisticated enough to be appreciated by the Doctors who works there.

Critical clinical content should be already expressed in its template designs. The system should be designed to be intuitive to the way Doctors work, for faster speed and accuracy from the start. Be sure you implement an EMR solution designed specifically for the target specialty.

Hence we can conclude that the failure risks lies in the mostly ignored pre-implementation phase and not just the adoption rate among Doctors. All of the above can be achieved if the pre-implementation phase is carried out properly keeping the end-user and client in loop.

The purpose of this paper is to focus the attention towards the pre-implementation phase of an EMR that contributes majorly towards the implementation and adoption success.

Several of these key success factors include: the importance of an incremental or gradual EMR implementation; templates designed around the clinical content of specific areas of specialty; and proper functional testing to ensure that lesser issue with low severity will occur during the Go-Live phase so that the more no. of issues will not affect the perception and adoption rates among the end-users, Thus contributing towards the successful EMR implementation.

B. Table of Contents

A. List of Figures

B. Acronyms / Abbreviations / Key words

- EMR — Electronic Medical records
- 21 CI — 21st Century Informatics
- HADF — Healthcare Application Development Framework
- HER — Electronic Health Record
- SQL — Structured query language
- KNO — Keel, Neus, Oor
- ENT — Ear, Nose, Throat
- OMS — Oral and Maxillofacial Surgery
- SPSS — Statistical Package for the Social Sciences
- CIS — Clinical Information System
- CPR — Computerized Patient Records
- HIMSS — Healthcare Information and management system society
- ROI — Return on Investment
- ICT — Information & Communication Technology
- SAP — SAP -ISH-med (HIS)
- HIS — Hospital information System
- GP — General practitioner
- EPR — Electronic Patient Record
- PROM — Patient Outcome Research Measurement
- RFP — Request for Proposal
- ICD — International Classification of Diseases

PART -I

INTERNSHIP REPORT

Part I:

Internship Report

1.1 Organizational Profile

Overview

21st Century Informatics is a global healthcare informatics solutions company. Its innovative healthcare informatics solutions are used by healthcare service providers such as Hospitals, Diagnostic Center and Specialty Clinics among others.

21st Century Informatics is headquartered in Amsterdam, Netherlands. With their Innovation and Knowledge centre in Mumbai (India), they service their customers across five continents with their regional offices in UAE, Saudi Arabia and India.

They are assisting medical institutions and managers of healthcare to dramatically increase their reach and productivity. Their transformative solutions improve the availability, accessibility and affordability of healthcare services. At the heart of their proven solutions, is the importance we give to people, processes and finally, technology.

They are driven by the mission and vision to transform healthcare service delivery through people, processes and technology. By using highly successful processes and path-breaking methodologies and processes, we transform the reach, scale, the quality and the affordability of healthcare services globally.

Mission

Healthcare is an information intensive field. Globally healthcare is constantly going through a series of changes due to advancement in medical technologies and new research findings. Even

with the advancement there is huge gap between care providers and patient. It is our mission to bridge this gap.

Innovation at 21CI: Transforming Healthcare

21 CI's innovations have helped its s, partners, care professionals and users transform healthcare. These innovations are a combination of processes and technology outcomes that make their solutions unique.

Their R&D team has successfully delivered HADF-Healthcare Application Development Framework and interfaces for various equipments used in healthcare industry.

With the aim of transforming healthcare service delivery, they have modeled a unique Innovation Strategy in the solutions they provide. This helps customers in the following ways

- Become more flexible and implement change management (as and when required)
- Provide access to latest tools and technologies in communication, data storage and archival
- Ability to integrate with upcoming technologies in diagnosis and treatment
- Knowledge acquisition, refinement and distribution to promote best practices.

Their innovation strategy relies on fine balance of internal expertise and external partners (in healthcare service delivery) to develop solutions that will help in transforming healthcare service delivery. The combination of Technology with Service Delivery gives this an edge over others.

Research & Development

21 CI's R&D strategy is focused on Applied Research to develop solutions that will transform healthcare service delivery globally. 21CI R&D Team undertakes targeted research and development work to address problems of healthcare service delivery.

Their applied research practices focuses on key areas of healthcare service delivery and management. Some of the areas on which our R&D team is working include:

- Automated Schema Mapping and Business Rules Engine for Configurability & Adaptability of our solutions by end-users

- Tele-Radiology and Tele-Pathology, Remote Telemetry
- Overall Data Security & Privacy
- Distributed and Cloud Computing

Solution & services

Healthcare Information System, Clinic Information System, Laboratory Information System, Advanced Imaging System, Electronic Medical Records and enterprise solutions

It also provides management consulting services to its s and healthcare organizations.

1.2 Area of engagement

The area of engagement in the organization during the internship was the EHR Project. An Electronic Health Record is an evolving concept defined as a systematic collection of electronic Health information about individual patients. It is a record in digital format that is capable of being shared across different healthcare settings by being embedded in network-connected enterprise wide information systems.

To carry out the implementation phase successfully and smoothly, the entire implementation process can be broken down into following phases-

1. Pre-Implementation
2. Installation and training
3. Go-live and post go-live support and maintenance

Being a Health IT professional and a management trainee I was engaged primarily in the pre-implementation phase for the EMR implementation project.
During the internship I was assigned the offsite-tasks primarily with the implementation team. But with the urge of learning more I also engaged myself in learning the front end configuration and issue correction with the configuration team.

1.3 Managerial Tasks

Management is required for every small, big, developing organization that wants to be successful. Even the smallest tasks require a managerial skill to handle it otherwise all the pain may go to vain if not managed properly.

Some of the tasks that were performed during the internship are as follows:

- Involved in some part of requirement gathering offsite via. Mail, phone, Skype sessions etc.
- Discussing about a requirement with the client via mail or phone to get the relative feedback
- Development of solution mapping document
- Development of test scenarios
- Development of Test Board for testing
- Preparation of training material for the end users
- Addition & configuration of masters.
- Taking SQL database backup & restore
- Functional testing of the software & creation of issue logs
- Issue reporting & follow up with different teams with respect to the pending issues
- Involved in Corrections of issues that required front end configuration.

1.4 Reflective Learning

As a trainee in 21 CI I have gained valuable knowledge in terms of actual application of Healthcare IT in the real practical world. It gave me a greater exposure to live examples of employing IT into healthcare. It helped me to develop the skills and knowledge which are must for very fresher who wants to carve his/her career as a Health IT professional.

I was assigned a project with the implementation & configuration team and I learned the following things:-

- Point to keep in mind for a successful implementation process
- Various stages & tasks performed to prepare a software for the successful Go-Live phase
- Barriers and challenges that occur during an implementation of an EMR.
- The basic workflow of the KNO & OMS department where EMR was supposed to be implemented.
- Documentation Process for the implementation projects.
- Configuration of Apex.
- Take back up and data restore for SQL server.
- To work efficiently within a team.
- How a controlled and fully managed work environment prevents the time delays in successful completion of a project.

Part II

Dissertation Report

Part II:

"Pre-Implementation phases during implementation of Apex EMR at a multispecialty Hospital"

Part A-Dissertation Overview

This dissertation is based on covering the pre-requisite pre-implementation phases for the Apex-EMR to prepare it for the final Go-Live phase, to reduce the risks and to increase the probability of implementation success.

Problem Statement:

A scenario has come that inspite of taking all the precautions during the development and coding for any sophisticated /EHR, implementations do fail and not always adoption rate in Doctors could be the excuse for the blame game. The reason being the lack of emphasis on the pre-implementation phases especially **requirement gathering & solution mapping, configuration of masters & different types of testing** of the software before the final implementation or the go-live takes place. This results in requirements and expectations of the end users viz. Doctors remaining unmet. What client wanted and what we are giving them at the end of the project for which they have spent or invested crores of rupees is of great importance for success & failure of any EHR implementation project. At the end of the day what actually matters is the satisfaction & acceptance of the system implemented by the client hospital which is directly proportional to the success rate of any EHR implementation. A client could be satisfied only if the requirements he gave were completely mapped and integrated within the EHR and he receives a system that accurately fulfills the requirements which he thought of while planning for the system as a deliverable.

Need of the study

Healthcare is a dynamic industry especially when it comes to different treatment plans for dynamic diseases which differ extensively from each other. In such cases the pre-Diagnosis

questions the doctor asks to a patient may differ, the investigation order may differ and also the inputs for the information about the progress of patient during the treatment plan and for each encounter may vary from specialty to specialty. Thus arise the need of proper requirement gathering and mapping a solution accordingly & accurately with requirements of the Doctors of that particular specialty & configuration of master data given by the hospital. One more stage or step which ultimately contributes to the success of an EHR implementation is Functional Testing & issue correction before the EHR goes live. It will check the extent EHR meets the client's requirements & to detect the gaps in the developed system that one can take the corrective measures. This will facilitate the smooth running of the EHR system during Go-live phase and reduces the percent of issues which may arise during Go-Live phase. Until unless we cover all the pre-implementation phases properly & completely we can never make any EMR implementation successful though it could have been proved the best for some other Hospital or doctor.

Objectives

General objective

To successfully cover the pre-implementation phases for the Apex to be implemented for KNO (ENT- Ear, Nose & Throat) & MKA (OMS-Oral Maxillofacial Surgery)

Specific Objectives

a) To gather specific masters and requirements from the KNO & OMS department of the Hospital

b) To map the AS IS....and TO BE...processes at the hospital via solution mapping process and come with the solution mapping document to give the base for developing & customizing the application

c) To add & configure masters for the application

d) To Design the test board & tests scenarios for the functional testing

e) Perform the detailed functional testing for Apex

f) Configure & resolve issues during testing till the system goes live

Study Design

This study used a descriptive, qualitative & to a little extent quantitative research methodology. Quantitative study is only for the testing phase of the main study.

Methodology

The Methodology adopted for the project is The **waterfall model** that is a sequential implementation process, in which progress is seen as flowing steadily downwards (like a waterfall) through various phases. The phases are as follows:

1. Requirements specification Design &
2. Solution mapping
3. Customization & configuration according to respective client
4. Testing and debugging(Validation)
5. Installation
6. Training
7. Parallel Run
8. Go-Live
9. Support & maintenance

Data Sources

The data was collected from primary & secondary data sources

Sampling Method

Sampling method was only used for the **requirement gathering phase** and that was random sampling.

Profile of organization & Respondents

The study is focused around one of the hospital in which EMR has to be implemented.

The respondents will comprise of physicians and nurses & receptionists of the same hospital.

Data Analysis

Data analysis will be done with the help of SPSS Version 16.0. and Microsoft Excel for the **testing phase.**

Data analysis for the testing phase was done. Data for errors of different severity level was analyzed and trend of error reduction was analyzed.

Outcomes

The outcome will be represented in the form of pie charts, graphs & bar graphs for the quantitative data (Testing phase)

Other Tools

- Microsoft Excel 2007

Work Plan

The activity table for the overall project is as follows:

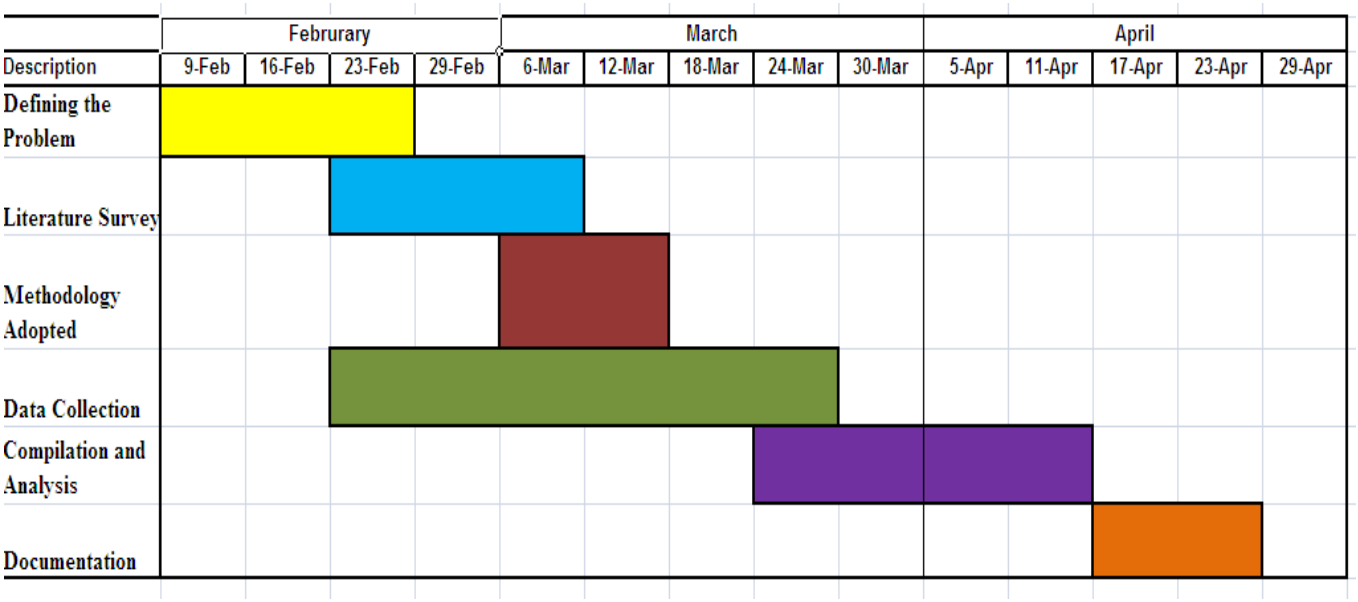


Fig 1 Project Work Plan

Part B Project Overview:

Chapter 1

1. Rationale

To carry out the pre-implementation phases successfully to prepare the Apex for the Go-Live stage, in order to decrease the risks and probability of implementation failure at the end of the project.

2. Introduction

The healthcare industry is in the midst of an exciting technology transformation. With governmental bodies, hospital's management calling out for widespread IT adoption, medical professionals are starting to heed these calls. Physicians of all strides are beginning to trade in their paper charts for software applications that help improve patient care, yield greater efficiency and productivity, and boost revenue.

As healthcare becomes even more complex, integrated, fast paced and quality demanding, electronic medical records (s) are becoming standard equipment. Potential advantages over current paper-base medical record include faster, portable and more reliable access to charts, instantaneous access to decision support from the simple (drug interaction flags) to complex (patient specific messages, e-prescribing), ability to rapidly formulate patient summaries for referrals and letters, integration of laboratory and pharmacy data directly into the patient record, ability to query the practice population to support preventive health maneuvers or research and tighter security.

Health Information technology has been widely touted as having the potential to improve the efficiency, cost-effectiveness, quality, and safety of patient care.

The transformation of health care services from manual processes to technology-enabled or automated clinical processes represents a big change in a clinician's daily work activities. Physicians, nurses, and other clinicians will be seeking new ways to improve patient care and their personal productivity while confronting the challenges of learning new processes and technology. They will all need support and encouragement to initiate and sustain these changes.

The true value of an advanced clinical information system (CIS) is to enable transformational change throughout a health care organization.

Among the various types of health information technologies, electronic health records have garnered the most attention from health care experts, policy makers, providers, clinicians, and the popular press.

Many delivery systems currently seek to improve the quality and efficiency of care through introduction of an electronic health record (EHR). Support for EHR adoption has come from government, private health policy organizations, and vendors; research identifies potential EHR benefits. Yet, accumulating field reports show that EHR implementations sometimes encounter major obstacles, fall short of expectations, or fail completely. The reality is that although many benefits could potentially be achieved through EHRs, approximately 50% of all health information technology projects either fail or produce suboptimal results.

Many providers are hesitant about investing in an EHR until they are more certain of its contributions to quality, efficiency, and their business performance. To attain EHR's full potential, its adoption and implementation should be treated as a means of facilitating redesign of outdated, inefficient, and error-prone care processes and a vehicle for organizational change—rather than just another information technology (IT) innovation.

Simple installing an EHR system will not bring about improvements in operational and administrative efficiencies. Nor will it result in higher quality, safer patient care.

So in order to get the right product customized according the customer that they welcome the change and ready to go against the internal inertia for the change the pre-implementation phase is of prime importance.

3. Literature Survey

According to Dr. Malcom MacEachem, father of medical record science, "medical record can be defined as clear, concise & accurate history of the patient's life & illness, written from the medical point of view, and in its true form is a complete compilation of scientific data derived from many sources, coordinated into an orderly document by the medical record department & finally filed away for various uses, personal and impersonal"

Clinicians who used CPRs found that electronic access to clinical information saves time and provides a thorough and efficient way to manage patient information.
A survey by Lenhart, Honness, Covington, and Johnson2 found that only 55 of 329 family practice residency programs (17 percent) were currently using a CPR. Similarly, only 13 percent of HIMSS 2002 Leadership Survey3 respondents reported having a fully operational CPR system.
Clinical benefits seen after implementing an EMR include: better access to the chart, improved clinical decision making and disease management. Second, CPRs improved clinical decision making and disease management through enhanced integration of treatment outcomes and reminders. Khoury and Tierney et al suggested that the EMR might be the only practical way to apply practice guidelines while clinicians are delivering care to patients.

Despite all of these benefits, testimonies, and recommendations, CPRs are not a standard in today's healthcare systems. The following barriers have kept healthcare leaders discussing CPR technology instead of adopting it: cost, leadership, ROI, vendors keeping up with users' needs, and deficits in the following categories: public policy, standards, security, and a true definition

A wide-ranging literature review of computer-based patient record (CPR) or EMR implementation over the past decade reveals that clinical, workflow, administrative, and revenue enhancement benefits of the CPR outweigh barriers and challenges — but only if healthcare organizations redesign certain work processes. The entire implementation process has to be re-engineered putting more emphasis on the pre- implementation phase. It is always easy to correct an error if found at an initial stage. A systemized planned and controlled pre-implementation phase makes sure to track down the errors and probable risks during the Go-Live phase. Among other key efforts, organizations must train and motivate users to navigate EMR systems, as well as develop a common structured language.

The Electronic Medical Record

Electronic Medical record is a comprehensive clinical information system that allows providers to electronically create, store, organize, edit, and retrieve patient medical records. Increasingly, EHRs are also being used to help health care professionals monitor the status of patient's health , provide computerized order entry and care decision support , improve adherence to clinical or

evidence-based guidelines , expedite patient referrals and exchange patient information among healthcare providers in a variety of settings.

Main Functionality of an EMR

1. Health information and data
2. Electronic Communication and connectivity
3. Patient support
4. Result management
5. Order entry/management
6. Administrative processes
7. Decision support

Advantages

1. Provide knowledge and decision support at the point of patient care to enhance its quality , safety, and efficiency
2. Support efficient processes for health care delivery (e.g. reduce redundant test ordering and other duplicate medical procedures.
3. Reduces medical record & transcription costs.
4. Improves frequency & use of alerts and clinical reminders among both staff and clinicians.
5. Serves as a comprehensive data repository for various administrative, reporting and funding purposes.
6. Improves potential for internal communications, patient care planning, follow-up, event tracking, patient referrals, ordering and accessibility of lab results.
7. Documents services received by the patient for legal and reimbursement purposes.

8. Improves accessibility, reliability, legibility and quality of patient's medical records

4. Product Overview

The EMR to be implemented at the multispecialty hospital is Apex EMR

Apex EMR

The Client Hospital is the first hospital in the Netherlands that works with Apex for selected partnerships. Apex was designed basically to digitalize the patient records and digitally capture encounter details.

Features taken into account while developing the Apex EHR are-

- ✓ ICT-Enabled specialty/doctor-based screens and workflows.
- ✓ Personalized Dashboards for CXOs, clinicians and managers, end users and patients
- ✓ A well designed web-portal integrated with the Apex as a platform to involve patients in their treatment plans and providing information even before patient visits the doctor thus saving time.
- ✓ Strategically aligning patient care units of outpatient and inpatient services for optimal patient flow along with a clinical process flow.

Basic Features of Apex are:-

- Capture encounter details
- Computerized order entry for investigations and procedure
- Computer based prescription
- Complaint Trends for treatment management
- Order sets for quick orders
- Sliders for viewing patient history and medical record summary
- Generate referrals
- Add, edit complaints and patient history and view medical records via web-patient portal.

Objectives of Apex implementation

At the end of the successful completion of this system, it expects to achieve the following business objectives:

1. Work has to be divided between Patient, Receptionist and Doctor to minimize the time spent by the Doctor
    a. Patient can put in the complaints and the progress against the old complaints. Patient can also put in consent for getting data from other Doctors, wherever necessary
    b. Receptionist can put in the relevant history
    c. Doctor can complete the history, record his findings and enter his orders
2. It should be possible for the Doctor to know the possible outcome for different treatment plans for a diagnosis.
3. Doctor should be having a single interface to view agenda, enter his notes, view nursing notes, enter operation notes and enter billing information.
4. The relevant data entered by other specialties should be available to the Doctor and vice versa
5. Doctor should be able to analyze the medical data and export analyzed data for **Random Survival Forest modeling**. Once the modeling is done, it should be possible to incorporate the formula in the system to derive the possible outcome for a given treatment
6. Patient should be able to view the entire medical record through the portal
7. Patient should also be able to view the possible outcomes for the treatment

Design of Apex

Apex was designed keeping in mind the doctor's perception and usability skill. It has the simplest one screen user interface so that any user even with the minimum computer skill can find it easy to use.

The most interesting part of Apex is the simple screens designed for nurse & doctor's consultation. It has only one consultation screen for both nurse & doctor log-in in order to avoid confusion ,otherwise Doctor & nurse has to go through a no. of screens and hence difficult to remember. To add the different category of data to be entered and captured during a patient encounter like patient demographics, procedures, investigations, previous medical history etc the screen has different nodes. Some of these nodes are present both in doctor's and nurse consultation screen whereas depending upon the user role doctor has more no. of nodes than the nurse for a particular consultation.

The components of Apex EMR can be classified as follows:-

1. User Desktop

Whenever a Doctor or Nurse logs-in into the system this they can see the user desktop. This user desktop can be configured by the end user depending upon what information they want to view.

Generally it has 4 sections-

1. Appointment list
2. Recent portal updates
3. Current inpatient list
4. List of referrals

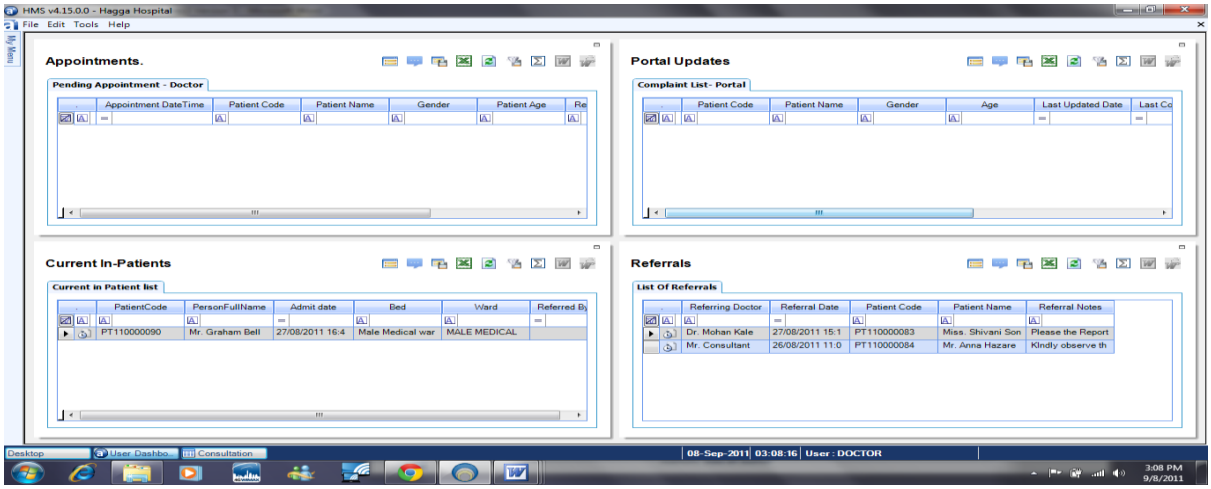


Fig 2- User dashboard

2. Consultation Screen

- Is designed in such a way that it would allow the doctor/Nurse to have an access of all the patient data through one screen.
- Nurse and doctor would be able to update/view/ change the details added by patient portal through the consulting screen and also can give orders for investigations and procedure via this screen after viewing the details added in portal. Thus patient can directly come with the investigation results for consultation.
- Consulting screen is divided into 6 parts.

1. Tool bar
2. Patient demographics
3. Encounter nodes

Consultation screen can be classified into two types:

a. Nursing Screen

This screen was designed according to the user role & authorization given to nurse.

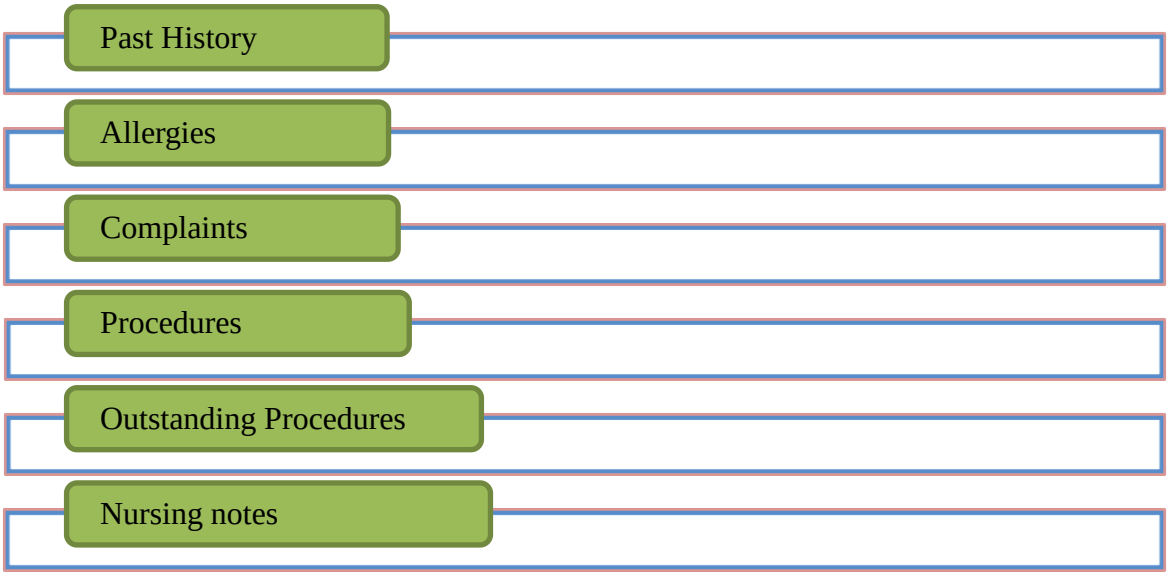


Fig 3 Nodes in Nurse screen

b. Doctor's consultation screen

- Is designed in such a way that it would allow the doctor to have an access of all the patient data through one screen.
- Depending on the user role it has additional notes to add details about the patient encounter.
- Doctor could edit details added by nurse via this screen as all the data will flow to this screen as well under the same node.
- Doctor can view details added by the patient via the patient portal and can edit them.
- Can give prescription, procedures and investigation order that get reflected in the patient portal.
- Apex EMR has the feature of computerized physician order entry when interfaced with respective clinical systems but was not given to the client hospital as they did not want it. All the prescription and orders were printed and given to the patient, appointment for the same were given via SAP-HIS.
- Doctor can give referral via this and referral letter will go to SAP via which they are mailed to the respective GP or Doctor.

4. Web based Patient Portal

Patient would be able to enter complaints, update status of previous complaints, see the outcome of treatment, give consent for sharing his/her data and update history from home through patient portal or kiosk at hospital. Nurse and doctor would be able to update/ change these details through the consulting screen.

5. Sliders

There were mainly 5 sliders-

a. **Summary of current patient encounter-** This slider will show the data whatever the doctor will enter in the nodes for the current encounter.

b. **Patient medical records-** This slider was used to see the details for the all the consultations.

c. **Summary of previous patient encounters** – This slider will have details in the form of tree nodes. Doctor has to click on the node heading and can view the details added under that as s tool tip.

d. **Summary of patient records**- this node was to view the summary of the complete medical record of the patient.

e. Trend chart for complaints- This slider show the graphical representation of trend all the complaints added for the patient as per the severity rated by the doctor. Complaints are nothing but diagnosis related questions designed by the doctors.

Doctor just required putting the cursor on the slider and the slider could be expand out in front of the doctor, no extra effort finding previous patient records by number or search.

Workflow of APEX

The patient will be registered, given appointment, marking patient arrival and billing will be done by the SAP software they have. KNO & OMS department will be having Apex for saving and storing the medical records for the patient. Whenever a patient comes for a KNO or OMS consultation he/she can add complaints online on the patient portal before coming to the hospital. These complaints are nothing but pre-diagnostic questions by doctors that helps in making the final diagnosis. Doctor/Nurse can see these complaints directly in their consultation screen which they can edit and increase- decrease the severity. Doctor will order investigations & procedures and will prescribe medicine using the Apex also they can view the previous records of the patient using the same screen.

*NOTE-The nodes were designed to be used for capturing the data for present consultation & when patient will come next time other than the allergies , complaints & present history other nodes will be empty. The patient data could be already present in patient history, allergies & Complaints if patient him/herself has previously added them via the web portal.

1.5 Project Background

This project is based on the pre implementation phases for the implementation of Apex at a Hospital in Amsterdam, Netherlands. The hospital is a multispecialty hospital, one of the known Hospitals in Amsterdam, Netherlands.

Apex, a 21 CI's solution was to be implemented at two departments namely KNO i.e. ENT (Ear, Nose, Throat) and OMS (Oral maxillofacial Surgery) at the's hospital.

For the successful implementation of Apex many pre requisite phases were covered to customize and configure Apex as per the needs of the hospital to prepare it for the final Go-Live phase.

Client Hospital is the first hospital in the Netherlands that works with Apex for selected partnerships. The SPD is mainly used in India, the Middle East and East Africa.

The hospital has chosen two kno departments and maxillofacial surgery patient records to be digitized. The electronic patient record (EPR) is linked to the existing hospital information system of the Client Hospital (SAP ISH-med). Apex was to be interfaced with the existing HIS-SAP of the Hospital. The main objective of the hospital behind implementing Apex was to achieve greater treatment success rate via a tool called PROM.

The Patient Outcome Research Measurement (PROM)-tool is responsible for the increase in treatment success. The tool works as follows. Prior to the visit to the doctor, the patient fills out an online form. This ensures that the history already known to the doctor. It is not that people do their own diagnosis, but to identify any symptoms or pain they experienced. If the patient then sits in the parlor, are the variables already in the system and get the doctor on the basis of variables and previous results predict which treatment is most effective.

Since the introduction of these standard questions, the success of the treatment after six months increased from 75 to 95 percent. With the PROM tool doctors can also collect data so that they better understand what works best course of care.

Doctor can easily customize the layout and content can manage. "It is not hard to program, but for simple changes in the layout or customizing the questions. So that Doctors do not fall back on externals. This saves time and money.

As Apex is an already developed product of 21 CI not much of coding was required. But to make it work according to the hospital further customization and configuration was required before it goes live. To meet this project objective the apex went through a number of stages during the pre implementation phases.

These stages are mentioned as follows:-

Stages	Time Period	Location	Team
1. Solution Mapping-Requirement gathering	1 week(Feb 3rd-Feb 8,2012)	Onsite/offsite	Implementation
a. Solution Mapping – Documentation	5 Days(Feb 11-Feb 15,2012)	Offsite	Implementation
b. Development of Test Scenario & Test Board	3 Days(Feb 16-Feb 18,2012)	Offsite	Implementation
2. Apex Configuration & customization	1 Month(Feb 20- March 14,2012)	Offsite	Development
a. Import of mater Data & master's configuration	3 Day (March 15 -17March 2012)	Offsite	Configuration
b. Manual addition of Masters for Treatment plan & configuration of medicine masters	4 Days (19-22nd March,2012)	Offsite	Implementation
3. Functional Testing	March 24th - Still continuing)	Offsite	Implementation
4. Installation at site & training	23th April- 25th April,2012)	Onsite	Implementation
5. Parallel Run	25th April- Still continuing	Onsite	Implementation

Fig 4 Pre- Implementation Project –work breakdown structure

Chapter 2-Data & methods

2.1 Methodology

The Methodology adopted for the implementation project is The **waterfall model** that is a sequential software development process, in which progress is seen as flowing steadily downwards (like a waterfall) through various phases. The phases are as follows:

1. **Solution mapping**

    a. Requirement Gathering
    b. Master Data Preparation
    c. Development of solution mapping documents
    d. Development of test scenarios and process scenarios.

2. **Development (Where required)**
3. **Configuration**

    a. Application Configuration
    b. Master Data import
    c. Manual addition of specific master data(Medicine master, order set)
    d. Master's Configuration

4. **Testing and debugging(Validation) & release**
5. **Application installation at site**
6. **Training**

    a. Key- User Training
    b. User acceptance test
    c. End User Training (By Key Users – Customer)

7. **Parallel Run**
8. **Go-live on new application**
9. **Initial Support post go-live**

10. **Reviews and Audits**
11. **Monitor and Control Risks**
12. **Change Management and Control**

2.2 Study Design

This study used a descriptive, qualitative & to a little extent quantitative research methodology. Quantitative study is only for the testing phase of the main study

A detailed study of entire implementation phase was done before starting the report. I went through all the implementation documents with 21 CI. These documents were used to record each and every small big detail about every stage under the implementation process. Observations were made for the current processes being a trainee during the first week of Feb 2012. A detailed hands-on training was given on the basic Apex to understand the flow of the system.

For literature review went through many pdfs, papers & articles on web about the successful implementation process and software development life cycle. Requirement documents for EMR and clinical care protocols were reviewed. Discussions and articles on reasons for EMR failure were analyzed and observations were co related to it while being a part of the implementation team for the pre-implementation phase.

Documents like daily, weekly & monthly site reports and other documents of previous implementation projects were reviewed and tried to study about the reasons that contributed to delay in project completion because of configuration, and new requirements issue etc.

2.3 Data Sources & analysis

The data was collected from primary & secondary data sources

Primary data sources

- Interview(Skype & phone sessions)
- Observation

- Discussion with development & configuration team
- Interviews & discussions(Onsite)

Secondary data sources

- Reviewing of the articles on web
- 21 CI website
- Implementation documents of 21 CI
- Client Hospital's website
- Apex Brochure
- Reviewed Literature;
- Various forms at hospital
- Documents & master data from Hospital.
- Solution Mapping Documents for Apex

Sampling Method

Sampling method was only used for the **requirement gathering** phase and that was random sampling.

Profile of organization & Respondents

The study is focused around one of the hospital in which EHR has to be implemented.

The respondents will comprise of physicians and nurses & receptionists of the same hospital.

Sample size

- Physicians: 15

- Nurse : 10

Data Analysis

Data analysis will be done with the help of SPSS Version 16.0. and Microsoft Excel for the testing phase.

Outcomes

The outcome will be represented in the form of pie charts, graphs & bar graphs for the quantitative data(Testing phase)

Other Tools

- Microsoft Project 2007
- Microsoft Visio 2007
- Microsoft Excel 2007

Chapter 3 Observations

3.1 Implementation process

Implementation is part of the process of designing a system and is a component of change. We develop a new information system to change existing information processing procedures and often to change the organization itself. Implementation refers to the design team's strategy and actions for seeing that a system is successful and makes a contribution to the organization.

Planning for the implementation is triggered as soon as the marketing team gets the deal signed from the as an agreement to the implementation after discussing the required demo of the solution to be implemented and scope of the implementation project with the exchange of supportive project documents.

Implementation Process can be divided into following phases-

a. **Project Initiation**- The initiation phase has the involvement and all the inputs from the marketing & pre-sale team. It has meetings with the s, developing RFP, Kick off meeting and sign off agreement for the actual implementation.

b. Project Execution- This starts with the development of the implementation project plan.

Planning starts with the discussions and meetings with the client prior to implementation discussing how and when the system will be implemented, when training
will be conducted for the staff etc. This planning also involves internal project plan, work division plan, which will perform what kind of activities during the entire implementation phase.

This can be divided into two phases-

1. **Pre-implementation**- This basically involves getting to know what wants and configuring and customizing the existing solution according to the . When the system is ready to be installed it's testing & error debugging to mitigate the risks during the final Go-Live phase.

2. **Actual Implementation & support-** This involves the Go-Live Phase and its support

c. **Project Closure-** After the successful Go-Live phase and the key deliverables being fulfilled, after the final sign off meeting when no issues are pending from the vendor's side as defined in the project scope, provides the sign-off document and thus project is closed. The offsite support may still be there as per the contract.

d. **Project Change Control-** This is a phase where the existing hospital where a solution was successfully implemented wants to add more features with extra cost involved or a migration project where client ants to upgrade the older version with the newer one.

The Main phase which was covered during the Apex- implementation was the project execution specifically the **pre-implementation phase**.

3.2 Pre- Implementation Phase of Apex

Pre-Implementation phase of any software is of prime importance. Successful completion of each stage under this phase is to ensure that right solution is created at the right time as scheduled in the project timeline. It reduces the chances of failure during the Go-live phase of the implementation process. It helps to reduce the severity and number of risks involved. If this pre-implementation is executed in a controlled way one can track the root cause of the issues that might arise during the testing or go-live phase.

The pre-implementation phase for Apex EMR can be broken down as follows-

1. **Solution mapping**
    a. Requirement Gathering
    b. Mater Data Preparation & collection
    c. Development of solution mapping documents

d. Development of test scenarios and process scenarios.

2. **Development (Where required)**
3. **Configuration**
    a. Application Configuration
    b. Master Data import
    c. Manual addition of specific master data(Medicine master, order set)
    d. Master's Configuration
4. **Testing and debugging(Validation) & release**

1. Solution Mapping

The objective of the "Requirements – Solution mapping is to find correspondences between solutions and requirements in order to compare expectations and requested solutions. In order to do this, similar conditions are necessary according to the interoperability context coming from different sources like role of organization, business process type etc. Based on the requirements, the mapping can be done by linking business needs and solutions. In this context requirements play the role for deeper specification of the industrial or scientific problem in order to support implementation. The approach is to map Business Needs (which are 1:1 correspondent to the interoperability issues) to solutions by using common context elements.

Solution mapping is done basically with the prime objective of mapping the existing fully developed solution with the requirements given by the client. Mapping is generally filling up the gaps between the requirements given by the client and the solution we have with us.

Solution mapping can be classified in four stages as follows:

a. **Requirement Gathering**

b. **Master Data Preparation**

c. **Development of solution mapping document**

d. **Development of test scenarios and test board**

a. Requirement Gathering

Requirements analysis in systems engineering and software engineering, encompasses those tasks that go into determining the needs or conditions to meet for a new or altered product, taking account of the possibly conflicting requirements of the various stakeholders, such as beneficiaries or users. It is an early stage in the more general activity of requirements engineering which encompasses all activities concerned with eliciting, analyzing, documenting, validating and managing software or system requirements

One of our most important jobs was to analyze every function of every job to understand how tasks were accomplished with the old system. The project team spent considerable time analyzing existing work processes, looking for opportunities for improved efficiency, designing new work flows that could be accomplished with the tools available in the EMR and developing a transition plan. Meetings during the implementation process, office and medical staff discussed and made plans for necessary changes in work flow that would make the best use of the EMR system.

Requirement gathering at client site

Requirement gathering was done for two departments namely KNO (ENT) and OMS (Oral maxillofacial surgery) of the multispecialty hospital in Amsterdam. It was a 1 week process at site. And remaining part and further discussions were continued offsite via, mail, chats, Skype sessions and phone conversation.

Since Apex EMR was already a developed solution, there was no need to start it from scratch. The basic design was there. The requirement gathering process was carried out with the prime objective to measure the gap in client's expectations and the solution. During this process AS-IS processes were captured i.e the current processes and flow of the departments.

All the test scenarios Normal as well as Exceptional ones were captured during this phase.

Sampling Technique

Random sampling technique was used for selection of sample for the two departments. This was because the no. of respondents was less. The hospital had nominated two chief doctors for the

respective department that will take part in complete implementation process from the beginning till end. These two doctors were the main respondents who conveyed the expectations and desired design for the EMR. Any suggestion or requirement has to be confirmed through these two Doctors only. They use to have meetings and discussion within their departments and came out with basic requirements.

Sample Size

Respondents	KNO	OMS
Doctors	**5**	**4**
Nurses	**5**	**7-10**
Receptionist	**4**	

Fig 5 Sample size for requirement gathering

The techniques used for the requirement gathering for Apex EMR were:-

a. **Discussions**- Discussion was the basic technique used as there were not many Doctors and nurses to be interviewed. Discussions were in person by the project owner who was sent to the site for gathering requirements. The important and almost all requirements regarding the system were gathered at the site only Remaining discussions continued offsite either via online chats, Skype sessions, via mail and via phone for some specific scenarios or outputs

b. **Prototype-** Since we already had the EMR developed, it was used as a prototype or the basic system through which Doctors could know how the system will work and what are the changes they'll require which were discussed and noted down. Different screens and templates were shown to the prospective end users and there feedback was taken.

c. **Brainstorming session**- Such sessions were conducted during the requirement gathering phase. The end- users were divided into two groups for each respective Department. One group consisted of the Doctors and other group was of Nurses. This session was conducted to know the perception of how they want the system to work when they'll actually be using it. Suggestion by Nurses & Doctors on the usability of Apex were noted down. Which fields were of more importance while recording the encounter details for a patient were suggested.

What work & authorization the nurses had was captured to give role –specific rights in terms of Nodes.

Information captured during the phase:-

1. **End Users Details**

No. of End users	Types of End Users
25	**Doctors, Nurses**

Fig 6 End user details

2. **Type of Data or information that was captured**

   a. **Templates & Outputs formats**- This basically involved going through the paper based-outputs they used. All the output formats were collected for making the templates. Information about the examination templates was collected for various nodes like examination, diagnosis etc.

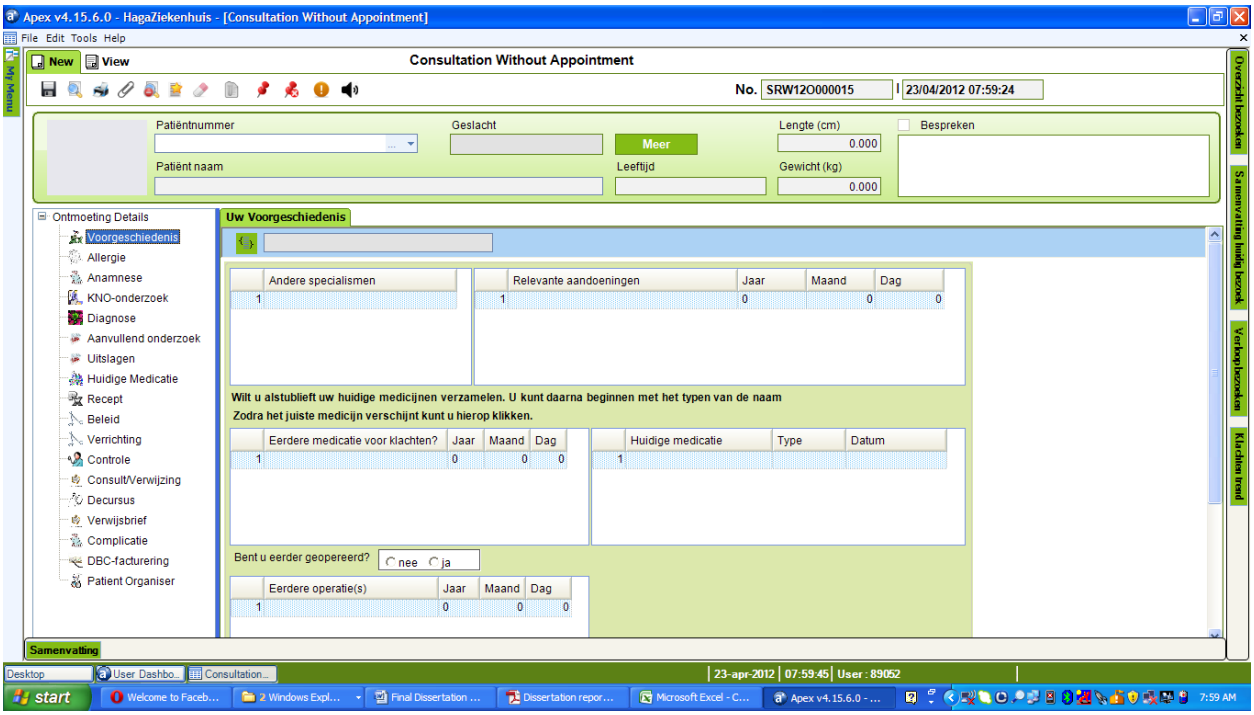


Fig 7 template for Past Medical History

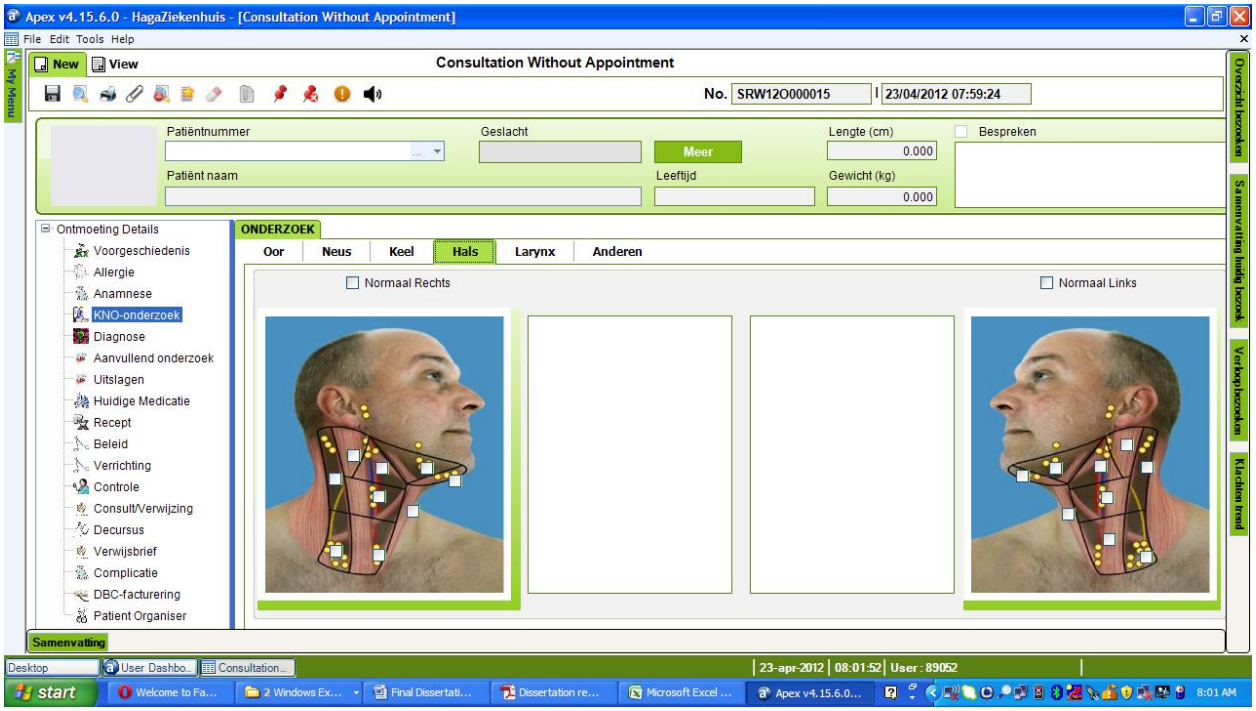


Fig 8- Template for Examination

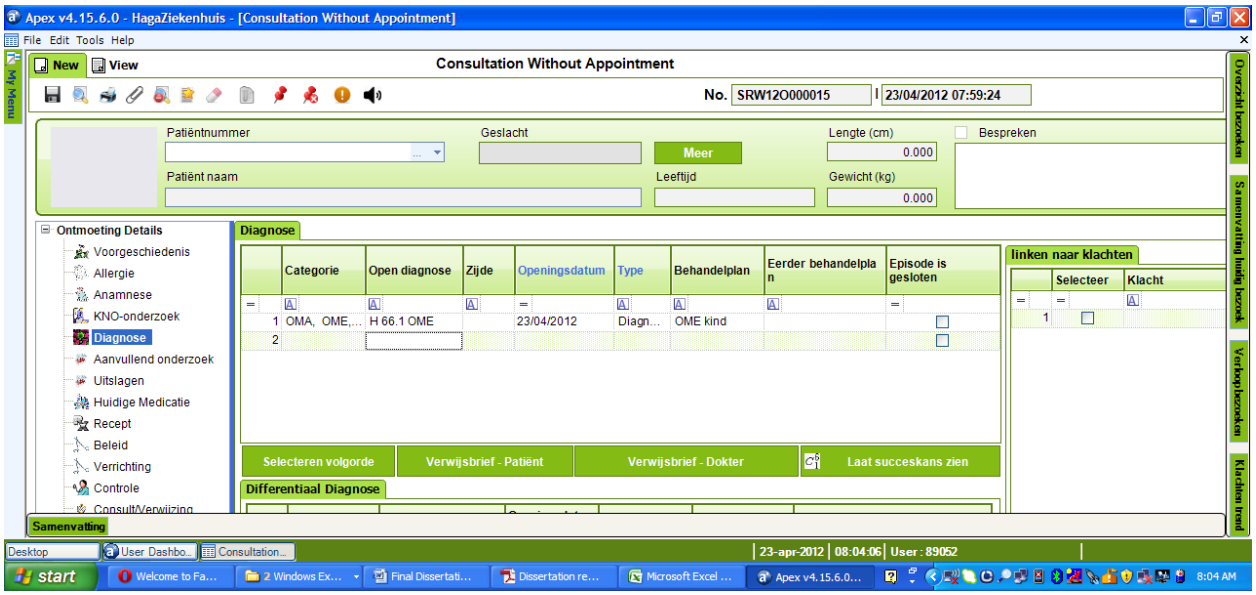


Fig 9 Template for adding Diagnosis

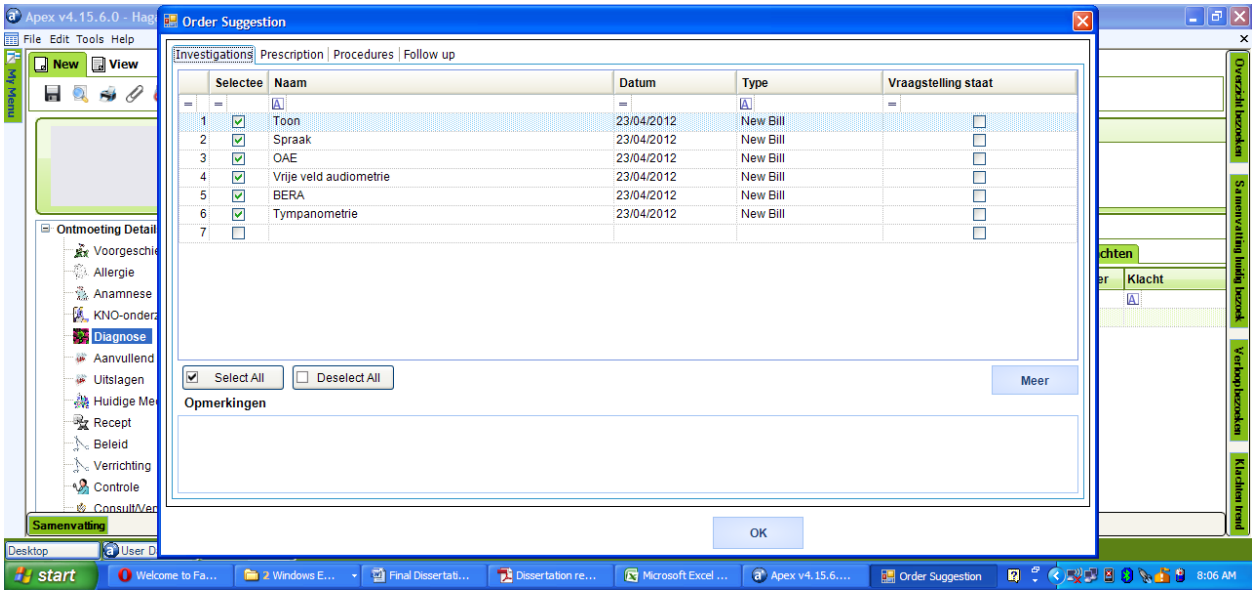


Fig 10 Order Set

b. Web- Portal Data & information

All the information about the patient portal to be created was collected as per the Doctor. What all details he wants patient to put online that the Doctor is prepared when patient visits the doctor for consultation. The portal was used to increase the success chances of the treatment as it will save Doctor's time for decision making and coming to the final Diagnosis.

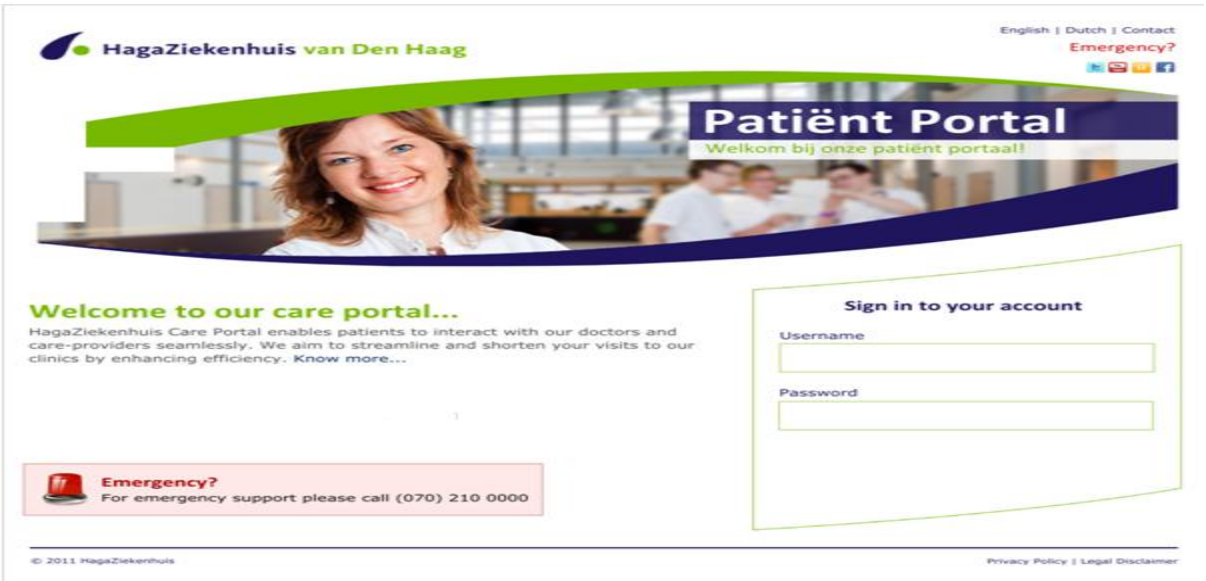


Fig 11 Patient portal

The patient could do the following things via patient portal-

1. Add/edit demographic details
2. Add Past Medical History
3. Add complaints
4. See his medical records
5. Make appointment
6. Give consent for data sharing
7. View investigation/procedures asked by the Doctor

Information collected for portal is as follows-

1. New patient who wish to make an account on the patient portal would be sent a onetime password through email after he takes appointment. This mail would be sent one day prior the appointment. Generate password would allow him to view the portal.
2. For certain answers in complaints, the patient would be given a pop up message and also, an email would be sent with the message; this would be used to alert the patient to seek urgent help from the hospital in case the answer is highly abnormal and requires immediate attention.
3. The details entered by the patient would get updated on the consultation screen, where doctor would read the history and complaints and may order some investigations before actually seeing the patient. Doctor would enter the investigations from consultation screen which would shoot an e mail intimating him to log in to the portal to see the investigations.

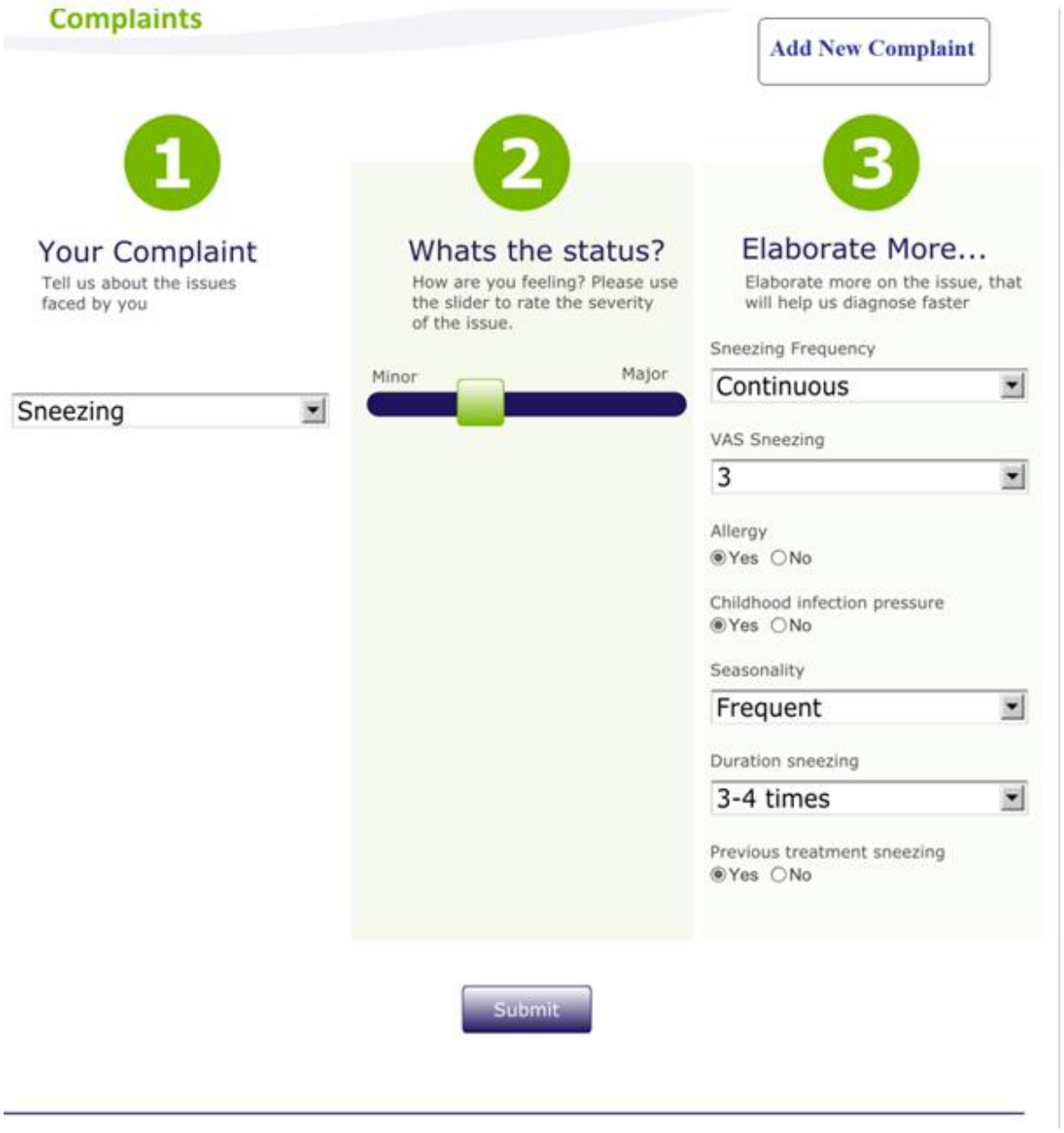


Fig 12 Patient Portal-Add Complaints

c. Interfacing Details

Primarily, the following interfaces have to be configured using HL7:

1. Apex to SAP
2. Apex to Laboratory
3. Apex to Radiology

4. Apex to Patient Portal

The details of the interface messages are as follows:

1. Patient demographics to be transferred from SAP to Apex
2. Patient portal to be enhanced to include Apex web part which will capture new complaints, updates on old complaints, history etc.
3. Patient appointments for consultation to be transferred from SAP to Apex
4. Patient arrival for consultation to be transferred from SAP to Apex
5. Lab & Radiology results to be available as a link for viewing from portal within Apex
6. Referral letters made by other departments / GPs to be available as a link for view from SAP to Apex
7. Current ward & bed details of patients within the hospital to be transferred from SAP to Apex
8. Investigation orders to be transferred from Apex to SAP
9. Referral letters made by ENT to be transferred from Apex to SAP as a PDF file
10. Relevant data to be transferred from Apex to SAP for data warehousing

d. Normal & Exceptional process scenario

These scenarios were recorded during the brain storming and discussions sessions. All the Normal and exceptional scenarios were taken care of and were recorded. These scenarios were used to create the test board for testing after the Apex was completely configured. All the scenarios were captured in the excel sheet and also using simple use cases. It involves the recording of AS_IS processes at the hospital.

The process scenarios were classified into two categories-

a. **Time- Based Process-** This included all the processes that take place at a particular scheduled time everyday or once in a month. Eg- Doctor taking round at 11.00 AM everyday is a time-based process

b. **Event-Based process-**This included the process which was triggered as a result of some event taking place. Eg- Patient comes to consult as per appointment

c. **Exceptional Scenarios**- These were the scenarios that took place at the hospital once or twice in a blue moon and not regularly. Eg- Patient calls for cancellation or changing the appointment, Doctor leaves for emergency.

e. Hardware configuration Details

Server-32 Bit Server

Ram-10 GB

Monitor Resolution- 1280 /2024

Sql server-- MsSql2010

Net Framwwork-2.0

Ms Office 2003

f. User Role & authentication Data

This data was collected talking to the Top management and with the help of the two main nominated Doctors. All the details regarding what is the role of nurse. What all details she can add edit and view in her screen were collected. Similarly which details patient can add, edit and see in the portal were noted down.

Depending upon the designation say trainee/Intern Doctors, Junior Doctors role & authentication rights were captured and mapped with the help of the password and user ID.

b. Master Data Preparation

Master data- This data is the uniform consistent data that does not change very often. This is the base data used by an information system to undergo certain transaction. Master data may include the No. of Doctors, Treatment plans, Medicines, Service charges, Diagnosis list etc.

For collection of masters or master data from the hospital a predefined format of excel sheet is used in which certain fields are made. The client is explained completely how to enter the master data in the sheet under the respective fields. The is given the blank Excel sheet in

which all the Masters are added by the people from the side and given back to the implementer at site during the requirement gathering phase.

Master data also includes the diagnosis questions for complaints to be added in the templates. Master data that was collected for Apex were-

Complaints, Examination, Diagnosis, Investigations, Procedures, Referral. In-house doctors, Nurses, order sets, Follow up, DBC codes, ICD codes etc.

c. Development of solution mapping document

Solution mapping documents were nothing but the outputs of the entire requirement gathering process. The main objective of these documents is to convey the gathered requirements and s need clearly to the Development team that they can customize the existing solution according to the . It reflects what all features and functions to be given to the based on the requirements and cost of the product.

Two documents for solution mapping were developed –

A. Volume 1-Processes & Policy

It consists of:-

- Process scenarios
- System Impact
- Interfacing Details
- Transition Plan

A.1 Process Scenarios

Volume 1 document contains all the process scenarios along with hospital policy captured from the client. The processes were conveyed either via simple use cases- or in tabular form. No hardcore use-case was followed. All the **time & event based scenarios** as well as **exceptional scenarios** were captured in this document.

Every scenario was explained first in the form of scenario Diagram showing the brief workflow is and then a tabular form which gave the details about the activities followed under a particular process and user involved.

The process were classified into two categories-

I. AS-IS process

These processes are the existing workflow at the hospital. It described the workflow before the implementation of EMR. It described all the manual processes and use of SAP wherever required.

Eg-

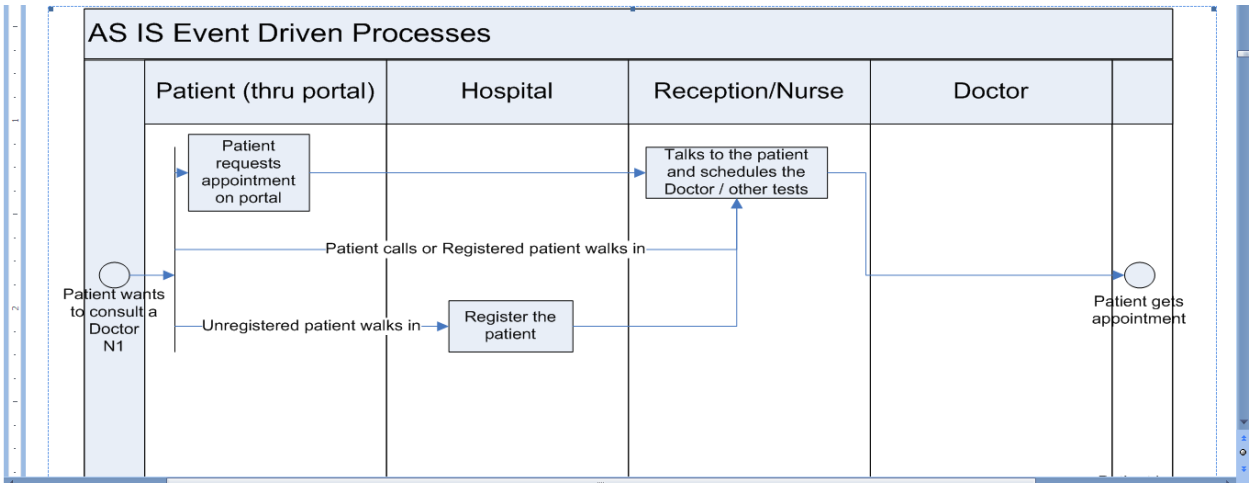


Fig 13- As-Is Process

Process Name	Activity Name	Role	Overview of the Activity
N1 - Patient wants to consult a Doctor	N1.1 - Patient requests appointment on portal	Patient	1. Patient selects the Department & the timing 2. He also gives some clinical details
	N1.2 - Talks to the patient and schedules the Doctor / other tests	Reception	1. Asks the patient a few questions 2. In SAP, Selects the appropriate Doctor and schedules the Doctor. Also, in SAP, schedules any tests required like radiology (this may be done by the Radiology Dept. and not by the ENT Reception)
	N1.3 - Register the patient	Hospital	1. In SAP, Hospital registers a new patient and generates barcodes

Fig 14- Details of As-IS Process

II. TO-BE process

These processes were the mapped processes which were created going through the requirements from the and the flow of the solution. It captured all the prospective workflows after the implementation of Apex EMR.

E.g.

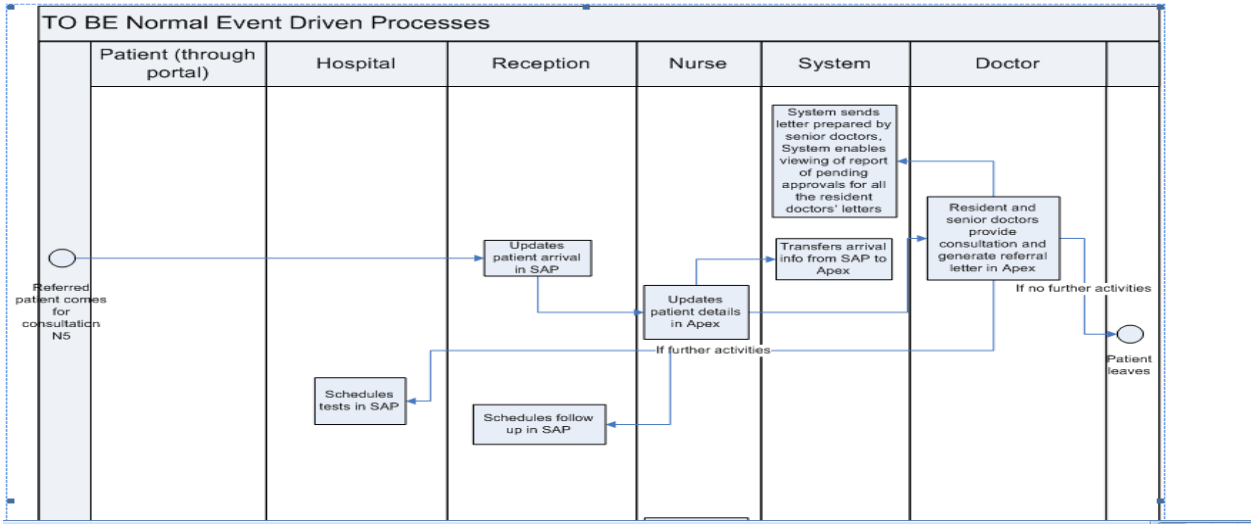


Fig 15 Snap shot -Event Driven process

Details of the TO BE Processes

Process Name	Alternate Flow	Activity Name	Role	Overview of the Activity
N1 - Patient wants to consult a doctor	1. Patient takes appointment through Haga portal	Schedules appointment in Haga Portal & enters/updates complaints & history in Apex portal	Patient	1. In Haga Portal, patient will schedule the appointment, in Apex portal enter/updates complaints & history
		Data transfer from SAP to Apex	System	1. Transfers appointment info from SAP to Apex
	2. A walk in unregistered patient comes to take appointment	Register the patient	Hospital	1. In SAP, Hospital registers a new patient and generates barcodes

A.2 System Impact

It is nothing but tabular representation of systems used during a particular process classified under AS-IN and TO-BE process.

System impact of TO BE Processes

No	Normal Event Driven Processes	SAP	Portal	Apex	Qlikview	Excel
FN1	Patient wants to consult a Doctor	Y	Y			
N2	Patient comes for consultation	Y		Y		
N3	Patient comes for admission as per surgery appointment	Y				
N4	Doctor perform surgery as per schedule	Y				
N5	Referred patient comes for consultation	Y		Y		
N6	Nurse marks patient for discussion			Y		

Fig 16 Snap shot -System Impact of TO-BE process

A.3 Reports

This section includes details about when and what kind of report should be generated.

A.3 Interfacing Details

This contains all the details about the required interfacing of Apex with other systems in use at the site.

A.4 Transition Plan

This section was to explain how the entire implementation plan will go focusing on the functionality of the system. The major decisions taken during the implementation that will affect the workflow. How a system will be used which functions are ignored or disabled during the beginning phase etc.

B. Volume 2-Activity Details

This Volume is focused on the Application or the solution to be implemented.

It will contain all the details about the Apex EMR. Its details like screens, nodes, templates, input data etc. This document is made by keeping the end users and project team from side in mind to make it easy for them to understand the detailed scope of the application. It explains in detail what all application can do or perform and how it can be done.

For Apex the Volume 2 was classified into sub headings that contained details about the headings. These headings were the functionality of the Apex. They are-

1. EMR
2. Project team
3. Verwijzing(reference)**Error! Bookmark not defined.**
4. Anamnese(Complaints)
5. Conclusie(Conclusion)
6. Behandeling(Treatment)

d. Development of test Scenario

This was a document that will be used for functional testing. The objective behind development of such document was to capture almost all the scenarios normal as well as exceptional that can be used for testing. This will help to test if all the scenarios are fulfilled by the application and if not then what kind of errors and issues are there. The issues that are reported during the functional testing phase are resolved to match and fulfill the idol scenarios mentioned in this excel sheet.

Test board in nothing but a kind of story board which has a scenario and fields to be filled when that scenario occurs. While testing the tester fills up the input values in front of those field which he/she made in the actual screen or system. Then depending upon the testing status updates in front of the test scenario if working correctly or not.

	Node	Test Scenario Background/Actions	Input values	Activity No.	To Be outcomes of the process	Testing status	Date
2		Register a new patient of age group 10-17Yrs					17/03/2012
3			Salutation-Miss		Patient Registered	✔	
4			Last name-Khatri		Registration No.	PT120000080	
5			First Name-Jyotsana		Check for data transferred from SAP : Patient name Patient code Photo if uploaded Email address	Pending	
6			Gender-female				
7			DOB-17/03/2000				
8			Age-12 Yrs				
9			Patient category- cash paying				
10			Suburb-elhi				
11			Country-India				
12			Member address-same as above				
13							
14		Give appointment for Dr. Blom.KNO Consult					17/03/2012
15			Service Name-KNO Consult	APP120000199	Appontment saved	✔	
16			Date-Today's date from calender-17/03/2012		Appontment No.	APP120000199	
17			Select Doctor-H.M Blom				

Fig 17 Test board for Apex

2. Development (Where required)

The development stage for Apex was of 3 weeks only. Since Apex was an already developed solution not much development was required. Though to prepare it according the s requirement and integrate the treatment plans and other clinical workflow into the EMR

some coding was done. It required SQL queries were run and SQL database for testing and implementation at site were created. This stage was covered solely done by the development team with assistance of the implementation team to understand the design and requirements.

3. Configuration

The construction phase begins with a heavy emphasis on learning the software and builds up to the launch of the system. During this phase, the focus should be on the details as the system is fine tuned and tested. Additionally, it is during this phase when the conversion of records takes place.

Once the application was ready to make it work according to the master data and appearance the way wanted some configuration was required time to time as directed by the implementation team for Apex. The configuration did not require any sort of coding but was done from the front end only.

a. Master Data import

As described in Master Data preparation an Excel sheet is given to the client which has a pre-defined format as per the development team. During requirement gathering it is explained how to fill the data in the sheet. Client fills up the entire master data related to the application and give it to us.

When the customization and required development is done and application is ready for testing this excel is imported into the application. And all the master data is saved in the application and available in drop down etc.

b. Application Configuration

EMR software alone will not be enough to meet the needs of medical staff. Optimization of the EMR software means creating templates, hammering out protocols, and communicating with doctors and staff to ensure that the system provides the right information in the desired way. This involved the configuring the various screen, defining the output format for each investigation and patient record. It also involved conditional configuration of various linked

complaints for example. A template for a linked complaint will open only when the Doctor or patient mark it as yes.

Apex can be configured from the front end using a separate log in and password. This screen is basically for the configuration of EMR. One just have to select the menu the/she wants to configure via the following screen.

From this screen respective templates are attached to the respective question or label.

Different UDF that were prepared by the development side are attached to wherever required using this login. This screen is also used if we want to add some specific masters into the application like the medicine master and order set which can not eb directly imported as are a bit complex as have many field and points to eb taken care of while adding.

Fig 18- Configuration screen (Complaints)

This screen is used for the following-

- Define, add, edit, delete labels

- Adding complaints, treatment plans
- Attributes or options for a particular complaints
- Adding order sets which require linking the diagnosis with the treatment plan and adding required medicines, procedures, investigations and follow up that will be directly available during consultation by one click on the treatment plan.

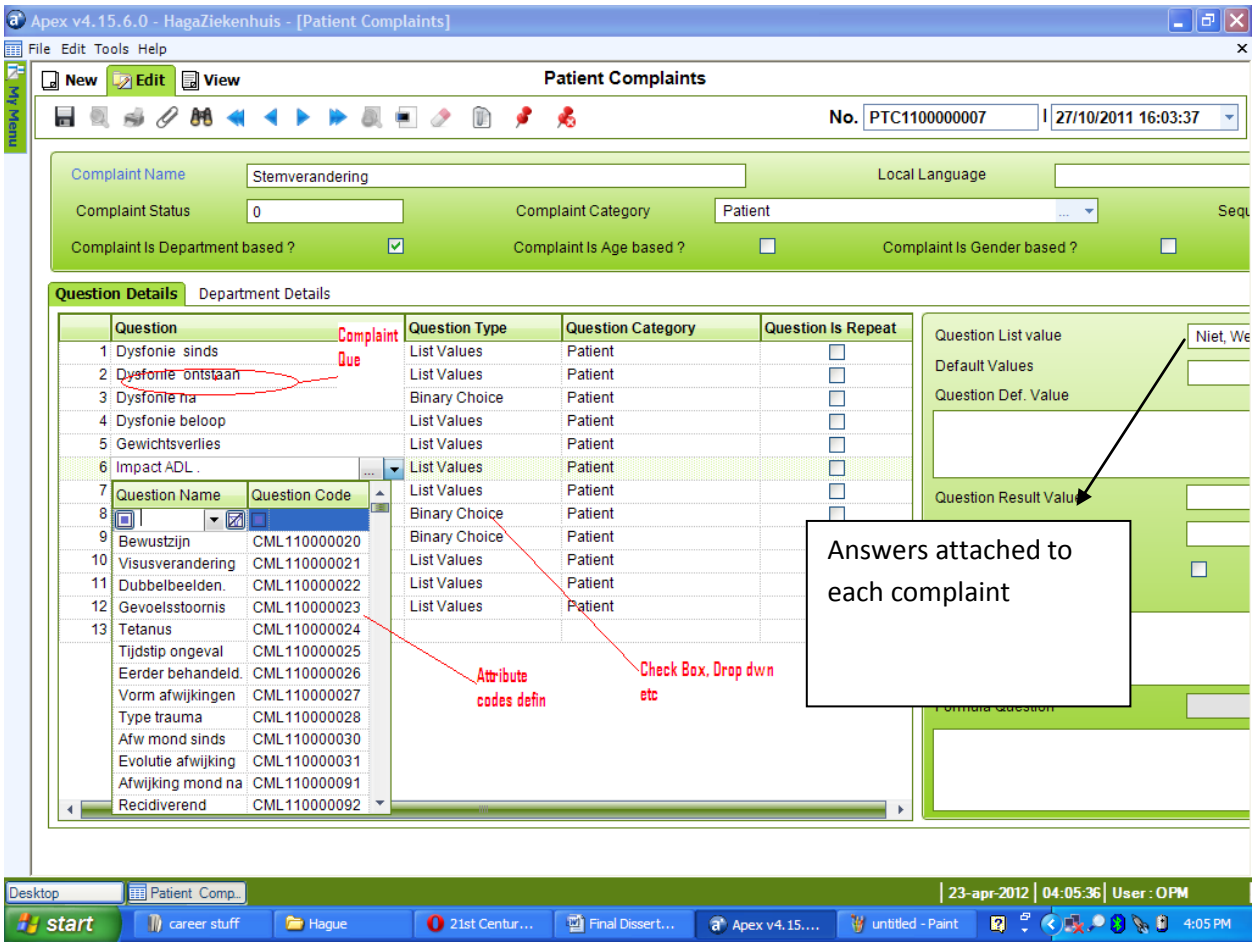


Fig 19 Snapshot-configuring a complaint template

c. Manual addition of specific master data

This stage took 4 days to get completed. Medicine masters and Order sets for all the diagnosis were manually added.

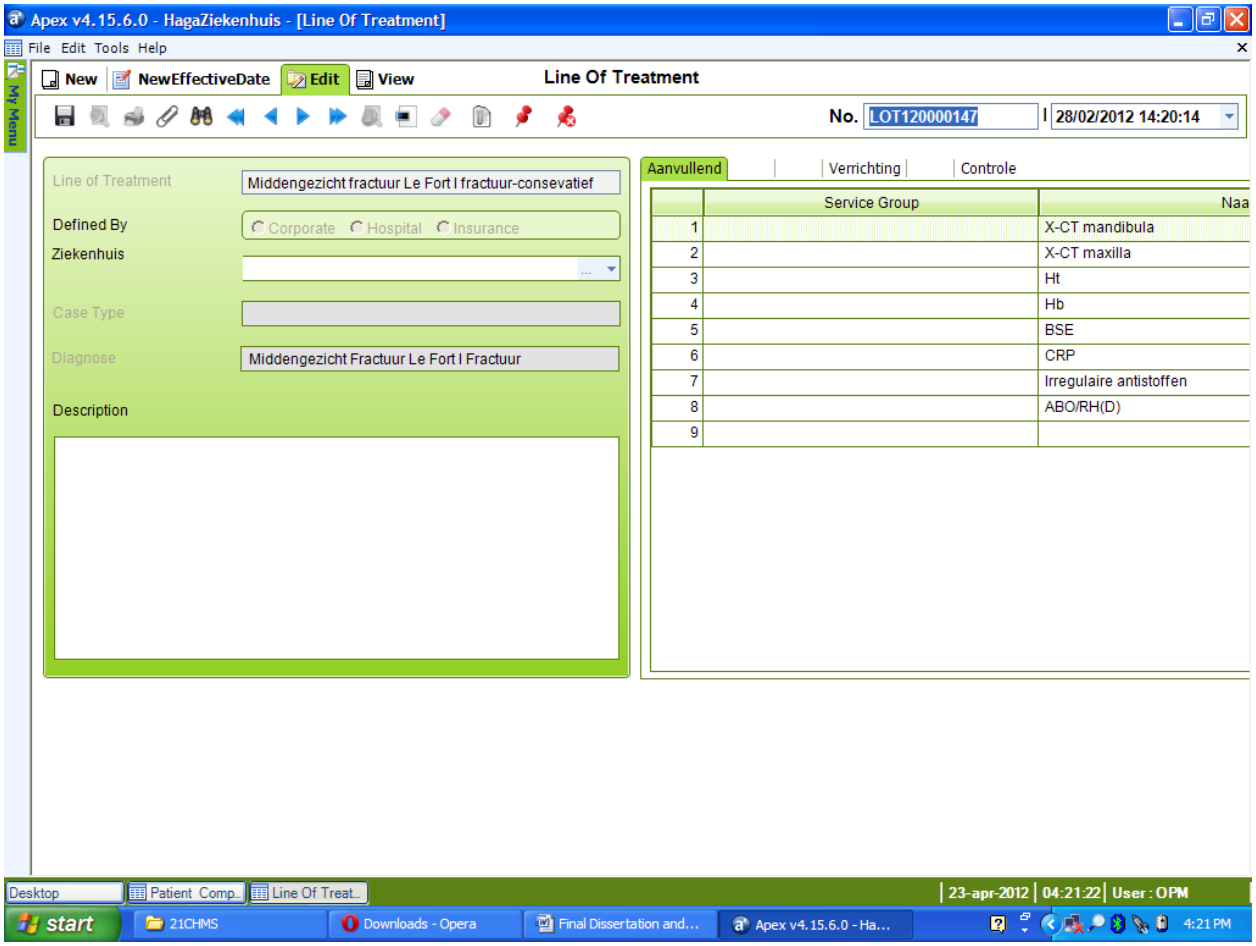


Fig 20 Screen for adding order sets.

4. *Testing and debugging (Validation) & release*

Software testing is an investigation conducted to provide stakeholders with information about the quality of the product or service under test. Software testing can also provide an objective, independent view of the software to allow the business to appreciate and understand the risks of software implementation.

Software testing can be stated as the process of validating and verifying that a software program/application/product:

- meets the requirements that guided its design and development;
- works as expected; and
- Can be implemented with the same characteristics.

Most of the test effort traditionally occurs after the requirements have been defined and the coding process has been completed having been shown that fixing a bug is less expensive when found earlier in the development process.

Testing for Apex

Software testing starts soon after the application's first release is given by the development team.

Testing is done at two levels after the first release-

For testing Apex the use case scenarios that were developed as the end result of the solution mapping process were used. Each scenario was tested on the software creating a test database. This test database was uploaded on the SQL server in use.

1. **Development Level**

a. **Sanity testing - Testing to determine if a new software version is performing well enough to accept it for a major testing effort. If application is crashing for initial use then system is not stable enough for further testing and build or application is assigned to fix.**

Major bugs of greater severity are corrected and only then the release 1 is given to the implementation team.

b. **Black Box testing**

Black box testing – Internal system design is not considered in this type of testing. Tests are based on requirements and functionality.

Soon after the software's release 1 is ready, first time testing is done by the development team. For testing they refer the test scenarios and test board provided by the implementation team after the solution mapping phase. It's not possible for them to test all the scenarios because of lack of domain knowledge but they check the general scenarios and work flow of the application to makes sure there is no such big critical bug that without which full release is a failure

The development team handover the software releases 1 to the implementers along with the test report made in excel in which it's mentioned which scenarios they have tested along with the input data they used for testing. the report also contains the scope of the solution mapping document that is unfulfilled in the 1st release and also when complete scope will be covered. An issue log is also attached with it to convey to the implementers the issues or bug that came while testing.

2. **Implementer's level (Functional Testing)**

   a. **Functional testing – This type of testing ignores the internal parts and focus on the output is as per requirement or not**

   It refers to activities that verify a specific action or function of the code. These are usually found in the code requirements documentation, although some development methodologies work from use cases or user stories. In case of Apex it was the test board and test scenarios. Functional tests tend to answer the question of "can the user do this" or "does this particular feature work." The system must be tested and tested again. Remember: anything that can go wrong will on a long enough time line. Fixing what is fixable and being prepared for what isn't will improve the user experience.

   The implementation team then tests all the scenarios using the same test board and gives the acceptance log to the development team if they think that main functionalities and basic requirements are fulfilled and integrated in the software.

3. **Customer level**

   a. **Acceptance testing -**Normally this type of testing is done to verify if system meets the customer specified requirements. User or customers do this testing to determine whether to accept application. This was done when apex was ready for installation after the rigorous testing phase when no major issues were pending.

   b. **Parallel testing**

   Parallel testing is done during the parallel run at the client site. In this kind of testing once the application is installed at the client's site, and system is used by the end- user for a

pre-defined span of time as a live system. All the transactions are done via the system for that duration of time. This is a kind of live testing with real scenarios. Any bug or issues that arise during this phase are conveyed to the offsite implementation team to get it resolved. The test/issue log may contain issues that aroused even during the off site testing or exclusively new issues.

This testing is done to make sure how the system behaves in a live environment and what are the possible risks and issues of criticality that should be resolved to make it function properly when the system goes live. It is to mitigate the risk involved for the Go-Live stage where a show stopper issue could create havoc.

For apex Parallel run was done for 2 Hrs every day as per the doctor's schedule.

Defects, bugs and configuration errors

A software bug is the common term used to describe an error, flaw, mistake, failure, or fault in a computer program or system that produces an incorrect or unexpected result, or causes it to behave in unintended ways. Most bugs arise from mistakes and errors made by people in either a program's source code or its design,

Software faults occur through the following processes. A programmer makes an error (mistake), which results in a defect (fault, bug) in the software source code. If this defect is executed, in certain situations the system will produce wrong results, causing a failure.

Errors or issues that aroused during Apex testing were classified under two groups:-

b. **Programming/coding Errors**

The issues or errors that are grouped under this category are those which require changes, editing or additional programming to rectify it. These errors arise due to some faulty mistakes in coding or due to some conditioning provided during programming. This condition was mistakenly given at times when the particular requirement was not understood completely and development team interpreted something else.

The examples of errors or issues of this category were some error message on clicking some button, some window not opening, disabled field in New, Edit or view mode , some condition missing etc.

These issues reduced with the time and regular testing and reporting and new releases.

ii. **Errors which required corrections in the master data configuration.**

These issues were simple issues related to faulty configuration settings or faulty master data being added. These issues were simple and were resolved either by a person in the configuration team or by the implementer itself. Issues reported under this category were a dropdown being left empty, wrong templates opening, wrong or missing labels or headings. Errors in output format and data to be interpreted in the sliders etc.

The severity of these issues was less and the time required to resolve them was comparatively lesser than those for the coding issues.

No. and percentage of such issues were always greater than the coding issues.

The errors were categorized according to the severity by the implementers keeping in mind the requirements and solution mapping document.

1. **High**- Errors grouped under this category were major programming errors; it also includes some configuration errors like some faulty configuration setting that resulting in wrong output etc. These errors were set as high priority errors. As they were of high importance from the client's perspective and took more time than medium or low priority errors were resolved first. Some errors reported under this category were also show stopper error that hindered the flow of the system.

2. **Medium**- These errors were important but could wait to be corrected as not interfering with the flow or application functioning.

3. **Low**- These included errors due to faulty entry of master data like spelling mistake, drop down in place of radio button. Some option missing from the dropdown etc. These errors required very less amount of time and could be corrected immediately from the front end only via the configuration screen. A separate person was assigned for this job.

Issue reporting & release

During testing to report the issues and bugs for debugging issue logs were created by the implementers. These issue logs were of two types-

1. Internal issue log (Prepared using excel by offsite implementers)

These issue logs were mailed to the respective resource for error correction via mail within the internal project management team

2. Online Issue log (to report issue by client or onsite implementers)

These issue logs were used to convey the issue rose during the parallel run or the go-live stage from site to the offsite implementation team. A separate id was generated for each issue with severity defined and online updation of issue status was done by the concerned person for correcting it. The testing for this issue was then done by the client and the on-site implementer and then case was closed.

The issue logs contained the following fields-

a. Date of reporting

b. Screen name

c. Issue Heading

d. Issue description

e. Screen shots

f. Assigned to

g. Status

New releases

A new release for the application or software was given at the end of the week in which previous issues were solved and debugged which was again tested and errors were recorded and reported.

Results for testing phase-

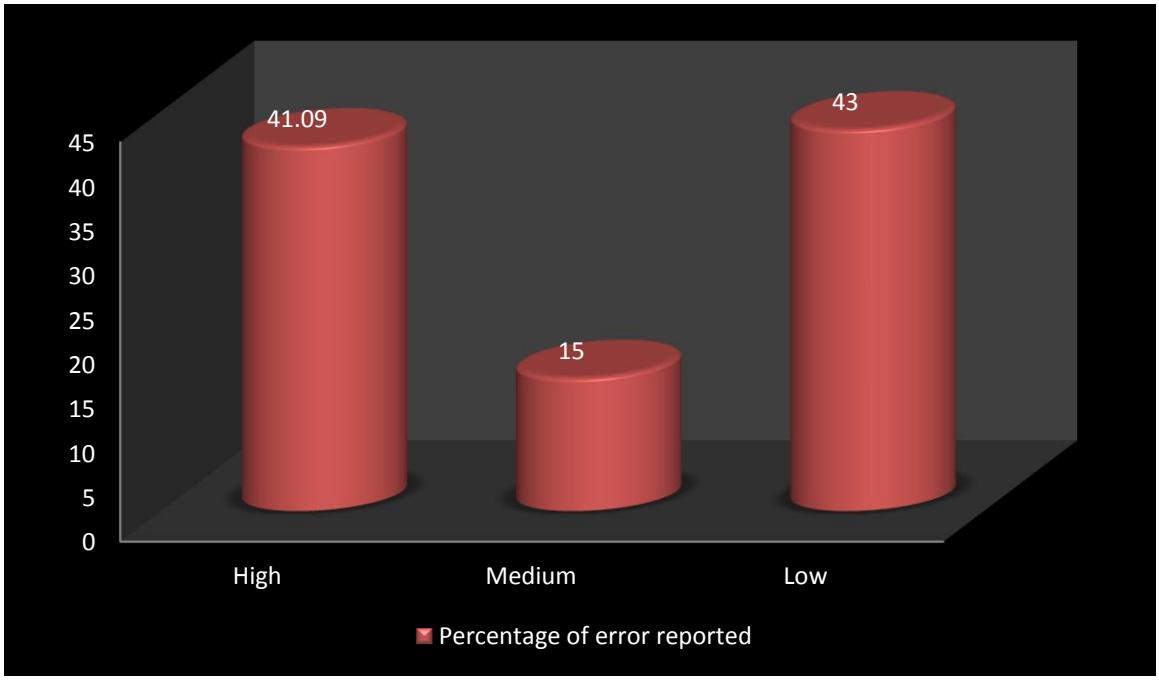
Issues/errors reported during the testing phase (5 weeks) were analyzed with respect to their severity.

The complete breakup of issues w.r.t the severity is given below:-

Issue severity	No. of issues
High	60
Medium	23
Low	63
Total	146

Figure Breakup of errors w.r.t severity (1st week of testing)

It was found that High and low severity errors were more as compared to the medium ones.



The graph showing the percentage of issues reported w.r.t the severity

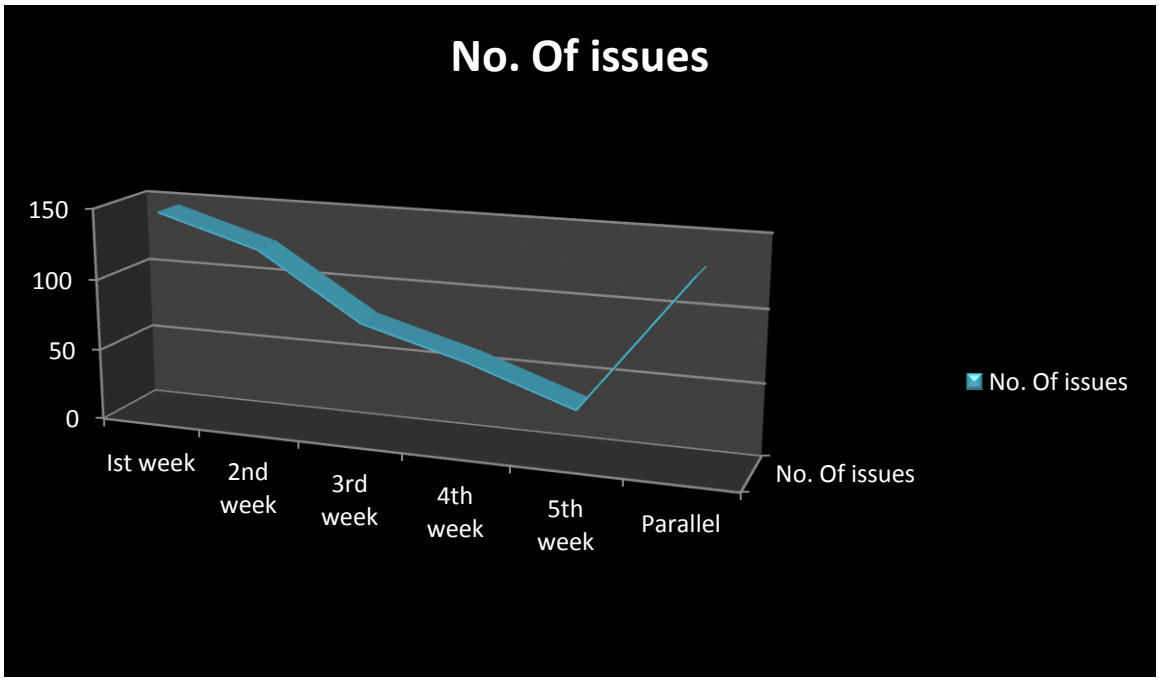


Fig- Graph showing trend of issue occurrence for the testing phase

Error trend showed that there were more no. of issues that occurred during the initial stage of testing which consequently reduced with rigorous testing and debugging. Even though the issues were reduced in offsite testing new and increased no. of issues were reported during the parallel run of the application at the client site in the live database.

Limitations of the Study:

- Patient view was not taken as they were already using a web portal to facilitate the patient
- Requirement gathering was descriptive or via Skype , mail and phone
- Study is more of a qualitative study and only a little part of quantitative one.
- Apex is not yet implemented so could not able to comment on the success factor but till parallel run the entire pre-implementation phase showed better results and reduced errors with client's appreciation with the system

Chapter 4 Discussion

Many delivery systems currently seek to improve the quality and efficiency of care through introduction of an electronic health record (EHR). Support for EHR adoption has come from government, private health policy organizations, and vendors; research identifies potential EHR benefits.1–5. Yet, accumulating field reports show that EHR implementations sometimes encounter major obstacles, fall short of expectations, or fail completely.

Out of all the reasons from most highly discussed reasons for EMR/EHR implementation failure the **Stakeholder and Process Requirements** is the Ranked 1.

The fact that this is the most significant topic of discussion is an indication that this has been a common stumbling point for organizations facing EMR implementation. For EMR implementations to be successful, organizations must consider all of the stakeholders of the EMR.

More specific details contributing to this topic are the failure of EMR vendors to follow through with their deliverables, their inability to provide customized solutions and features, and their failure to facilitate a successful "hand-off" to their customers. No matter how sophisticated a system, is bound to fail if it is built upon poor processes and does not fulfill for what it was designed for.

When the final product is released for the use, it should have everything what the Doctor expected from it when thought of buying an EMR. Thus the pre-implementation phases, **requirement gathering** and integration of care plans as per the physician is of prime importance. This also requires customization & configuration of the application. To check if the right product is developed and produces right results testing comes into picture. Rigorous testing and issue resolving cannot reduce the issue occurrence to zero during the Go-Live phase but it minimizes the no. of un-expected issues during that phase which will have structured solution to get it resolved quickly. Hence increases the chances of success and better adoption rate amongst doctors as you have given them what they have asked for.

To attain EHR's full potential, its adoption and implementation should be treated as a means of facilitating redesign of outdated, inefficient, and error-prone care processes and a vehicle for organizational change—rather than just another information technology (IT) innovation

Chapter 5 Conclusion

With The implementation of Apex EMR the two departments can gain following benefits:

i. Better and quick quality of care delivery to the patient

ii. Ambulatory consultation service.

iii. Improved disease management.

iv. Increased treatment success rates via PROM.

v. A tool for scientific research for disease management.

vi. Digitalization of all the Medical records for KNO & OMS department

vii. To be an excellent tool for monitoring health maintenance and doing reminders, providing accessibility of information, increasing the quality of information, improving clinical processes and clinical data capture, reducing medical errors, and increasing productivity

To achieve this project team is required to make sure that

1. Apex is fulfilling all the client's requirements
2. Apex is accurately mapped & customized according to the client's current process or if integration of best practice process is done then are they acceptable to client.
3. All the bugs & errors are detected, tracked & corrected at the offsite level only before the system goes live.
4. Proper monitored & controlled testing that if any similar or same issue arises during parallel or go-live phase it could be resolved in shortest span of time possible as they'll be aware how & who resolved this issue earlier.
5. Proper end-user training along with documented and supportive training material.

6. Keeping a record of all the phases covered under the implementation project by documenting every process

In the pre-implementation phase are sown the seeds of success or failure. Once an EMR implementation begins, it is very difficult and expensive to return to this phase and start again.

A fully documented, monitored and controlled pre-implementation phase is a must pre-requisite and contributes majorly towards a successful EMR implementation.

Chapter 6 Recommendations

i. During the development and implementation phases of a blended learning approach, it is vital to consider a variety of stakeholder perspectives (organisation, instructor and most importantly, the end-user or learner). Failing to do so represents a significant risk. A consideration of the identified areas in this review from all relevant perspectives is necessary.

ii. User involvement in the design process should be there for the entire process of EMR implementation.

iii. The system should be pre-tested before go-live and installation at client site in the conditions that reflect as much as possible the actual conditions prevailing during its implementation via parallel run. Implementation of a systematic and proactive monitoring mechanism during the pre-testing & testing phase should be there to facilitate follow up and tracking of pending and resolved issues.

iv. Pre-implementation phase should have highly controlled and monitored evaluation mechanism. A complete documentation process during this phase will help to monitor and control the process and help in mitigation of risks involved.

v. The goal of monitoring and evaluation is not to focus on what is wrong and condemn it; rather, it is to highlight the positive aspects of the system that make it work, as well as to identify what went wrong as a basis for improving the system.

vi. Find bugs as early as possible and make sure they get fixed before the software goes live, that no bugs arises in front of end-user and will doubt their acceptance of the system.

vii. Create test cases in such a way that testing is done to uncover the hidden bugs and also ensure that the software is usable and reliable

viii. Front-end Configuration training should be provided to at least one person at the client site, so that issues of lower severity can be solved without increasing the load on the helpdesk and whenever client wants he can get his system configured himself .

Chapter 7 References

8.1 Journal

Adams, A. M. (2004). Pedagogical underpinnings of computer based learning. *Journal of Advanced*

Nursing, 46(1), 5-12.

8.2 Paper

Akkoyunlu, B., and Yilmaz-Soylu, M. (2008). Development of a scale on learners' views on blended learning and its implementation process. *The Internet and Higher Education*, 11(1), 26-32.Baldwin-Evans, K. (2006). Key steps to implementing a successful blended learning strategy.*Industrial and Commercial Training*, 38(3), 156.

8.3 Article in journal

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Beadle, M., and Santy, J. (2008). The early benefits of a problem-based approach to teaching social inclusion using an online virtual town. *Nurse Education in Practice*, 8(3), 190-196.

8.4 Article on web

http://help.utest.com/testers/participation/submit-reports/classifying-bugs

8.5 Research paper

Best Practices in EMR Implementation: A Systematic Review

Karim Keshavjee, John Bosomworth, John Copen, James Lai4, Beste Kucukyazici5,

Rizwana Lilani, Anne M Holbrook1

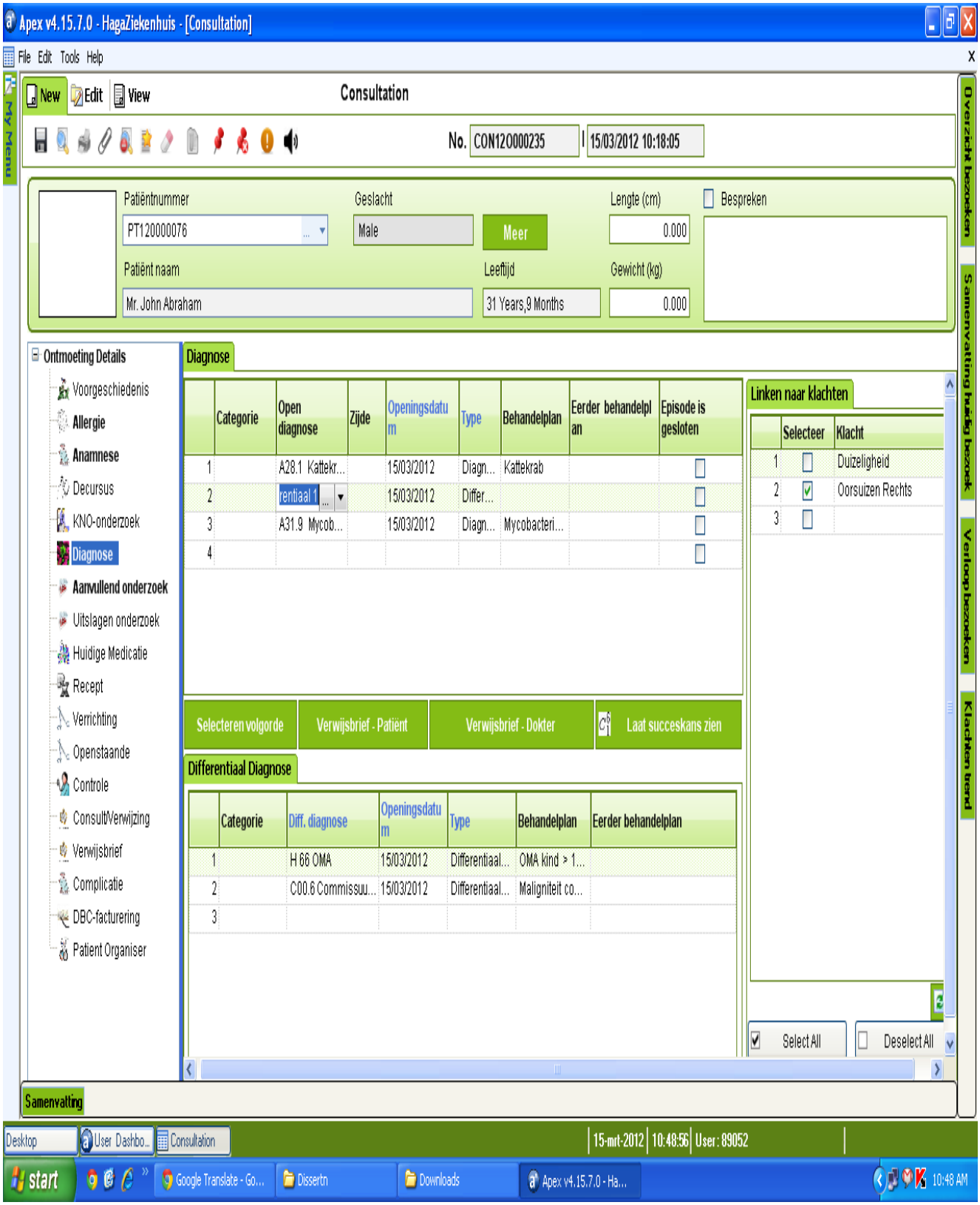
8.6 White Paper

Implementing an System: One Clinic's Experience

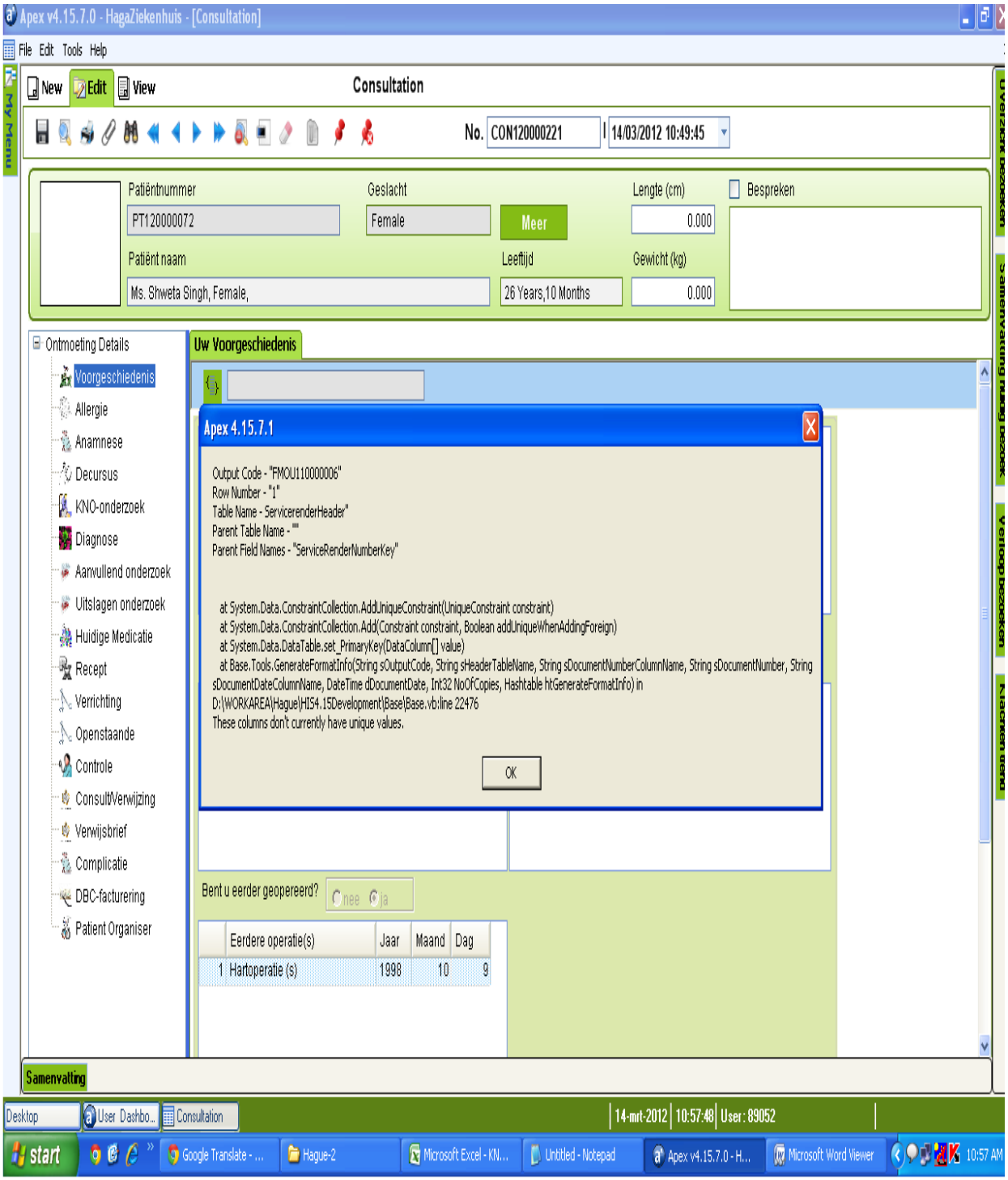
8.7 White paper

Eight steps for successful implementation- 2009,Mike Sappington, CEO of gloStream

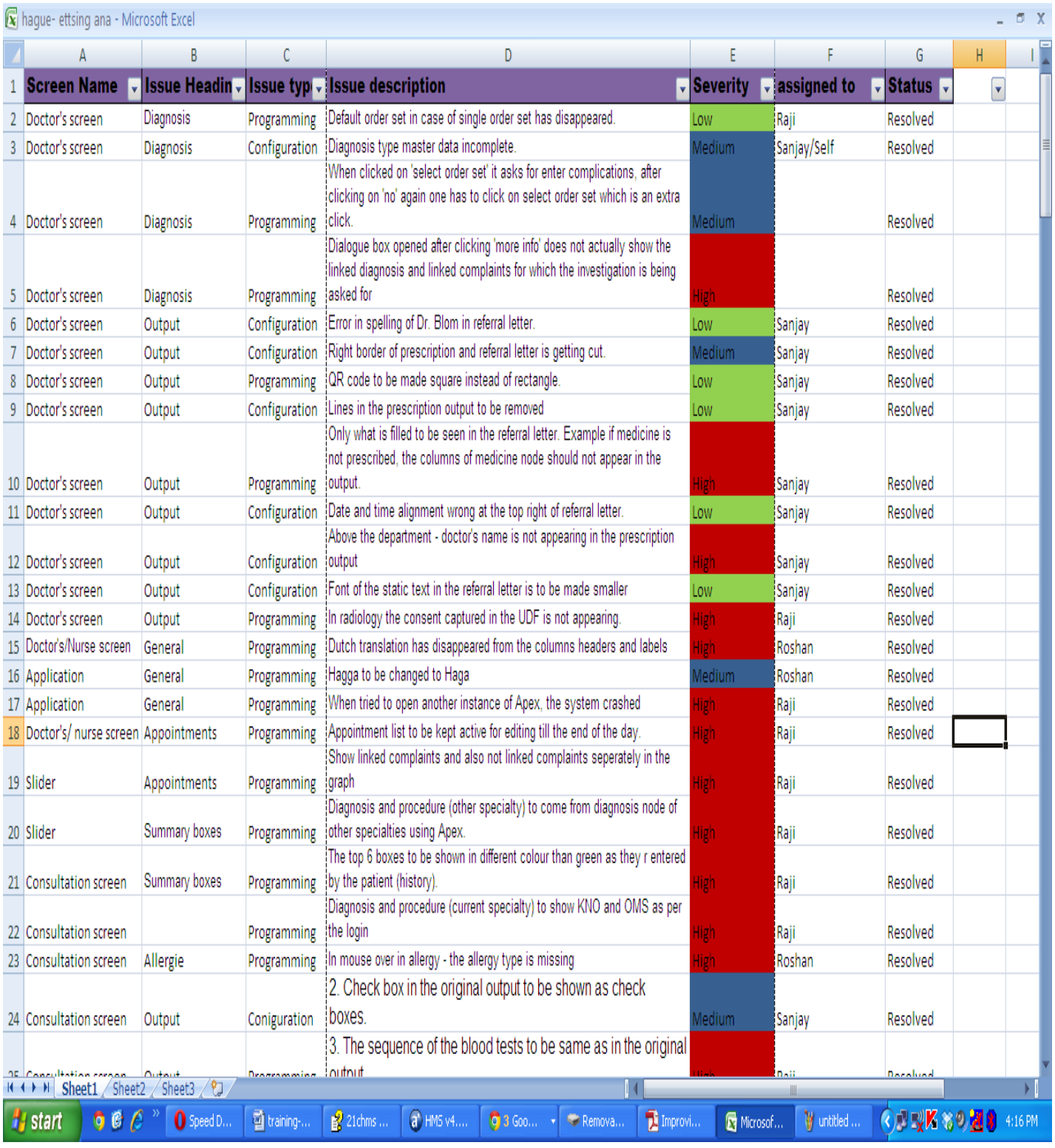
ANNEXURES



Consultation screen



Coding error in Apex



hague- ettsing ana - Microsoft Excel

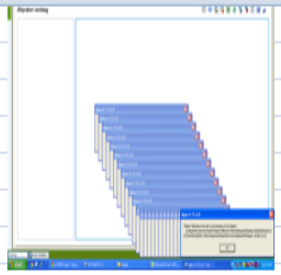
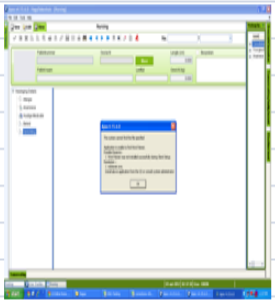
	Screen Name	Issue Headin	Issue typ	Issue description	Severity	assigned to	Status
2	Doctor's screen	Diagnosis	Programming	Default order set in case of single order set has disappeared.	Low	Raji	Resolved
3	Doctor's screen	Diagnosis	Configuration	Diagnosis type master data incomplete.	Medium	Sanjay/Self	Resolved
4	Doctor's screen	Diagnosis	Programming	When clicked on 'select order set' it asks for enter complications, after clicking on 'no' again one has to click on select order set which is an extra click.	Medium		Resolved
5	Doctor's screen	Diagnosis	Programming	Dialogue box opened after clicking 'more info' does not actually show the linked diagnosis and linked complaints for which the investigation is being asked for	High		Resolved
6	Doctor's screen	Output	Configuration	Error in spelling of Dr. Blom in referral letter.	Low	Sanjay	Resolved
7	Doctor's screen	Output	Configuration	Right border of prescription and referral letter is getting cut.	Medium	Sanjay	Resolved
8	Doctor's screen	Output	Programming	QR code to be made square instead of rectangle.	Low	Sanjay	Resolved
9	Doctor's screen	Output	Configuration	Lines in the prescription output to be removed	Low	Sanjay	Resolved
10	Doctor's screen	Output	Programming	Only what is filled to be seen in the referral letter. Example if medicine is not prescribed, the columns of medicine node should not appear in the output.	High	Sanjay	Resolved
11	Doctor's screen	Output	Configuration	Date and time alignment wrong at the top right of referral letter.	Low	Sanjay	Resolved
12	Doctor's screen	Output	Configuration	Above the department - doctor's name is not appearing in the prescription output	High	Sanjay	Resolved
13	Doctor's screen	Output	Configuration	Font of the static text in the referral letter is to be made smaller	Low	Sanjay	Resolved
14	Doctor's screen	Output	Programming	In radiology the consent captured in the UDF is not appearing.	High	Raji	Resolved
15	Doctor's/Nurse screen	General	Programming	Dutch translation has disappeared from the columns headers and labels	High	Roshan	Resolved
16	Application	General	Programming	Hagga to be changed to Haga	Medium	Roshan	Resolved
17	Application	General	Programming	When tried to open another instance of Apex, the system crashed	High	Raji	Resolved
18	Doctor's/ nurse screen	Appointments	Programming	Appointment list to be kept active for editing till the end of the day.	High	Raji	Resolved
19	Slider	Appointments	Programming	Show linked complaints and also not linked complaints seperately in the graph	High	Raji	Resolved
20	Slider	Summary boxes	Programming	Diagnosis and procedure (other specialty) to come from diagnosis node of other specialties using Apex.	High	Raji	Resolved
21	Consultation screen	Summary boxes	Programming	The top 6 boxes to be shown in different colour than green as they r entered by the patient (history).	High	Raji	Resolved
22	Consultation screen		Programming	Diagnosis and procedure (current specialty) to show KNO and OMS as per the login	High	Raji	Resolved
23	Consultation screen	Allergie	Programming	In mouse over in allergy - the allergy type is missing	High	Roshan	Resolved
24	Consultation screen	Output	Coniguration	2. Check box in the original output to be shown as check boxes.	Medium	Sanjay	Resolved
				3. The sequence of the blood tests to be same as in the original output			

Sheet1 Sheet2 Sheet3

start Speed D... training-... 21chms ... HMS v4.... 3 Goo... Remova... Improvi... Microsof... untitled ... 4:16 PM

Apex Issue log

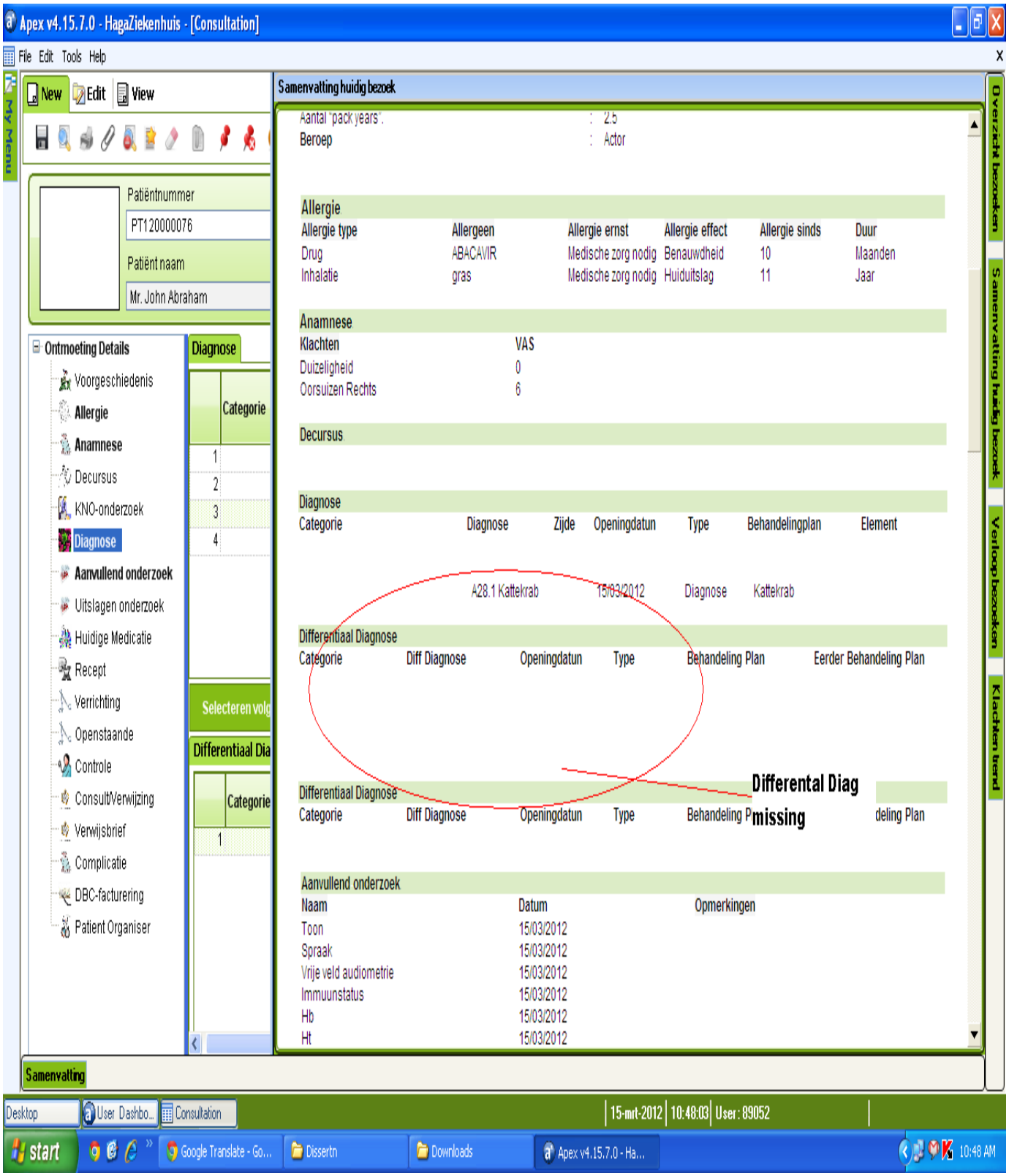
KNO-Testing - Microsoft Excel

	A	B	C	D	E	F	G
29							
30							
31							
32							
33							
34							
35							
36							
37							
38	30/3/2012	Nursing/Allergie	opmerkingen(comments)	Free text not working	Low	self	Resolved
39	30/3/2012	Nursing	Voorgeshiedenis(history)	Node not avialable	High	Raji	Pending
40	30/3/2012	Nursing	Nursing Notes	Node not avialable	High	Raji	resolved
41	30/3/2012	Nursing/consultation	Print Preview	Error message	High	Raji	resolved
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52	30/3/2012	Nursing	sliders	canot see allergy and history added by nurse in Samenvatting huidig bezoe(current summary)	High	Sanjay	pending
53	30/3/2012	Consultatuion	Recept	cant see medications which are there in the order sets	High	Swati	pending
54	30/3/2012	Consultatuion	Order sets	cant see medications which were added in masters of order set	High	Swati	Need to discuss
55	30/3/2012	Consultatuion	Sliders-Samenvatting huidig	Dates unavilable for investigations	High	Sanjay	resolved
56							
57	30/3/2012	Consultatuion	Verrichting	Cannot see the procedures entered by the nurse	Pending	Raji	
58	30/3/2012	Nursing	Linked complaints	error message -when try to open the template on selection of "Ja"	Resolved	Swati	
59							
60							
61							
62							

Sheet1 Sheet2 Sheet3

start | Speed D... | training-... | 21chms ... | HMS v4.... | 2 Goo... | Disserta... | Improvi... | Microsof... | KNO-iss... | 4:29 PM

Apex Issue Log-2



Slider – error in diagnosis-Missing Differential diagnosis