Institut für Parallele und verteilte Systeme

Universität Stuttgart Universitätsstraße 38 D - 70569 Stuttgart

Fachstudie Nr. 196

## Vergleich von Gesundheitsdatenmodellen

Georgios Balatzis, Tim Borner, Oliver Röhrdanz

Studiengang:

Softwaretechnik

Prüfer: Betreuer: begonnen am: beendet am:

Prof. Dr.-Ing. habil. Bernhard Mitschang Dr. rer. nat. Matthias Wieland 16.03.2014 16.09.2014

**CR-Klassifikation:** J.3 LIFE AND MEDICAL SCIENCES

# Contents

Co	ntents	5
1.	Intro	oduction6
2.	Defi	nitions7
2	2.1	EHR, EMR
2	2.2	ASC X12
2	2.3	CEN/TC 251
2	2.4	DICOM
2	2.5	ISO TC 215
2	2.6	xDT9
-	2.7	HL7 Standard (Health Level 7 Standard)9
3.	Ope	nMRS11
4.	Cais	is19
5.	NOS	H25
4	4.1 Prc	vider Account
4	4.2 Ass	sistant Account
4	4.3 Pat	ient Account
6.	Micı	osoft HealthVault
7.	Ope	nEMR
(	5.1 Do	ctor Account
(	5.2 Pat	ient Account
8.	The	Carrot
9.	Mirt	h Connect / DHIS256
10.	C	omparison
11.	C	onclusion60
Tab	ole of I	-igures61

## 1. Introduction

According to researches done by the WHO, asthma is a common disease all around the world. Asthma is characterized by recurring symptoms such as coughing, chest tightness, reduced oxygen saturation and shortness of breath. Sometimes it requires even an emergency admission. Supervising and taking care of these patients can dramatically reduce the time needed for convalescence. Therefore it is recommended by the ECHO-Project to supervise asthma patients using online systems and modern smartphones or web browsers. To keep track of the patient's data it needs an electronic health system to manage these data.

The goal of this study is to evaluate several existing platforms and systems to store and manage health care data. The final platform should be able to keep track of current and past data sets. Furthermore it shall offer a dedicated doctor account which can make recommendations to the patients and dedicated patient's account in which they can enter measured data and vitals on their own.

# 2. Definitions

## 2.1 EHR, EMR

A electronic health record (EHR) also called electronic medical record (EMR) is a general and abstract description of electronic saved data containing patients demographics, medical history, medications, allergies, immunization status, laboratory test results, radiology images, vital signs and personal statistics. It is thought of as one 'file' that contains all the data so it is easily updatable, so it contains always the most recent data and it is possible to exchange the data between health care systems.

[This brings a lot of positive aspects against paper-based data on the on hand as it needs less space to save all the data and it is easily shared and saved at multiply locations and can improve the quality in health care. It makes it easy for a consistent standard of documents and offers the possibility to trigger warnings or reminders. But on the other hand there is the possibility to 'hack' into the systems and steal the data or damage the systems.]

For the technical implementation of the transfer of this data there are several standards that will be presented briefly in here.

## 2.2 ASC X12

The ASCX12 (Accredited Standards Committee) is an organization which develops xml standards for the electronic data exchange and is chartered by the American National Standards Institute (ANSI). The standards are mainly used in the USA.

## 2.3 CEN/TC 251

Cent/TC 251 is a European workgroup working on standardization of health information and communication technology. They made for example the *EN 13606* which is a standard for interoperability between health care systems, it defines a stable standard for EMR exchange between different systems. Also they made the EN 13940 which is a system of concepts to support continuity of care. A third standard is EN 12967, the Health Informatics Service Architecture, it should define an architecture enabling openness, integration and interoperability amongst healthcare information systems and also a methodology to describe healthcare systems through a language, notation and paradigm suitable to facilitate the planning, design and comparison of systems.



Figure 1. Specific models and communication interfaces http://www.consorzioedith.it/public/immagineDocHisa.bmp

## 2.4 DICOM

DICOM or ISO 12052 is an international standard for interchanging medical images. It defines the formats of medical images and is implemented in almost every radiology, cardiology imaging and radiotherapy device.

## 2.5 ISO TC 215

This ISO contains technical specifications for EHRs, this contains also the HL7 data exchange standard that is described in more detail below.

For example ISO 18308 defines requirements for the architecture of a system that processes, manages and communicates EHR information.

## 2.6 xDT

xDT is a group of data exchange formats used in the German health care, there are different formats e.g. the ADT format for transferring billing data, the BDT format for exchange of complete EHRs, the GDT format to transfer data among medical devices and software systems and the LDT format to transfer orders to laboratory tests and results.

## 2.7 HL7 Standard (Health Level 7 Standard)

A lot of Hospitals and Organizations that provide Healthcare, use an enormous variety of computers and devices to track a patient's Health, to bill and organize the clinic. This variety of computers and devices need somehow a way to communicate through Interfaces. Rising problem is that not all devices and computers, are able to communicate per default with each other. Health Level 7 provides some standard guidelines, standards and methodologies, which allows the devices to exchange data. It can be viewed as a Framework for exchange, integration, sharing and retrieval of Medical Information, as it defines how Data should be packed and communicated between the peers, setting up the language, the Data Structure and the Data Types. The guidelines set from the Health Level 7 standard are supposed to force the Developers of various platforms and health care programs that are going to be used, to not export various types of Data or Data Formats, but to use a uniform Data type. The resulting export should be easily shareable Information between Health Organizations using the standard. This ability to exchange information should help to minimize the tendency for medical care to be geographically isolated and highly variable. Management, evaluation of Health services, delivery and clinical practice are supported, as it is the most commonly used in the whole world Standard. The Health Level 7 Organization was founded in 1987, when in the United States of America, the Organization announced to public a set of Norms. The name HL7 comes from the seven levels of the Open Systems Interconnection (OSI) model. Level Seven is the Application Level. This Norm set was thought to set a standard for data processing of administrative and medical Data. Vision of the Organization is to create the best and most widely used standards in healthcare. Nowadays the Health Care 7 Organization, has Affiliates Organizations in over 30 Countries, with the first affiliate Organization founded 1993 in Germany. The standards of Health Level 7 can be easily found on the official Website [1] of the Organization. Selected products and standards are provided by no cost Licenses. Standards of Health Level 7 can also be found under the ANSI/ ISO/ HISTP standards, as it provides the whole life cycle from development, adoption and market recognition until the utilization and adherence of the products. Those Standards are grouped into seven categories by reference:

- 1. Group Primary Standards: Most frequently used and asked Standards in this are to be found in this Group. System Integrations, inter operability and compliance.
- 2. Group Foundational standards: Technology infrastructure that must be implemented by the developers of Health Level 7 Standards. Also the Fundamental tools and building blocks, used to build the Standards themselves.
- 3. Group Clinical and Administrative Domains: Messaging and Document Standards (Format) for clinical specialties are described in this Section. This Group is taken use of usually after Group 1 (Primary Standards) is implemented.
- 4. Group EHR Profiles: The Standards that provide profiles and functional models for electronic health records and management.

- 5. Implementation Guides: Guides and Support Documents for the use of conduction with an existing standard (Supplemental and supportive Documents and Documentation for parent standards, parent components)
- 6. Rules Section: The technical Specifications, programming structures and guidelines for software and standard Development.
- 7. Education and Awareness: (DSTU's) Draft Standards for Trial Use and current projects are found here. Tools helping to understand and adopt the Heath Level 7 Standard.

The Members themselves are also organized into workgroups. There are Meetings of those workgroups three times per year at various locations, where the members meet each other and work together on the standards and educate themselves and the IT Community. Those Meetings are open for everyone to join and most of the working groups recruit developers through them, as HL7 is a volunteer organization. Every Member is encouraged to be participate in all Work Groups, as the Work groups are responsible for defining the standards. Also every Work Group has two or more head chairmen. There are three kinds of membership. Individual membership in which the member is personally interested in the Standard, the affiliate membership and the organizational membership for members who want to use the standards as part of their business plan.

## 3. OpenMRS

OpenMRS is a worldwide community of volunteers from many different backgrounds. Some of them are involved in the health-care system directly, other have a technological backgrounds. Together they aim to create one of the most flexible and largest technology platforms for medical health-care. The project itself is mainly written in Java with some JavaScript and Ruby which is typical for a web based application. The full source code and project are released under its own license which builds on the existing Mozilla Public License 1.1.

There exist some OpenMRS demos to give the user a taste of the Software based on different point-ofviews.

sername:		Password:		
nter your username		Enter your pa	ssword	
Inpatient Ward	Isolation Ward		Laboratory	
Inpatient Ward Outpatient Clinic	Isolation Ward Pharmacy		Laboratory Registration Desk	
Inpatient Ward Outpatient Clinic	Isolation Ward Pharmacy		Laboratory Registration Desk	

Figure 2. Login screen for the OpenMRS Platform

As early as the user visits the page, he has the ability to choose the location for his session. The user needs to provide his username, a password and the starting location for his current session to login and continue.



Figure 3. Welcome Page, logged in the Inpatient Ward

After logging in the user is greeted by a clear arranged and neatly looking menu which provides him the main functions of the application. On the top right hand side the user can see his name as well as the current location he is logged in at, and of course he can log himself out there. For the user it is also possible to change his location directly in the main menu without the need to log out first and later log in again. He just needs to click onto his current location and is prompted with all the possibilities where he can choose his new location from. Available are, as already seen on the login screen, the Inpatient Ward, Laboratory, Outpatient Clinic, Pharmacy and the Registration Desk.

			🐣 admin	♀ Inpatient Ward +	Logout 🕞
Find Patient Record	1				
Find Patient Record	d				
Search by ID or Name					
Identifier	Name	Gender	Age	Birthdate	
1004EX Recent	Kimberly Johnson	F	34	19-Feb-1980	
1007GM Recent	Mike Jones	M	66	17-Nov-1947	
Showing 1 to 2 of 2 entries	5			First Previous 1	Next Last

Figure 4. Patient record overview

In the main menu the user has the ability to find a patient record in the database. By selecting this option the user has the ability to find a record on a patient. Per default the recent patients are listed there, in our example this are two people. In case the user wants to search for any non-recent patients one can do so by just clicking into the search bar and entering either the name of the person or the unique Identifier. To gain more information about a specific patient one just need to click onto a patient's name.

	🐣 admin	♥ Inpatient Ward - Logout
> Johnson, Kimberly		
Active Visit	.Feb.1980) Edit	Patient ID (1004E)
🐩 DIAGNOSIS	🛗 visits	
Viral conjunctivitis	Today Active - Outpati	ient Current Visit Actions
Retained placenta or membranes, without Hemorrhage	23.Oct.2013 Outpat	ient <b>O</b> End Visit
Perineal laceration during delivery	02.Apr.2013 Outpati	Admit to Inpatient
Jaundice	13.Mar.2013 - 16.Mar.2013 Inpatie	ent S Capture Vitals
Other Noninfectious Disorders of Lymphatic Channels	27.Sep.2012 Outpati	General Actions
hookworm disease	Show more in	Add Past Visit
Sexually Transmitted Disease		S Merge Visits
VITALS		
Last Vitals: 23.Oct.2013 04:22 PM		
Height (cm) 127.0Cm		
(Calculated) BMI 105 4		
Temperature (C) 36.0°C		
Pulse 172/min		
Respiratory rate 11/min		
Blood Pressure 192 / 28		
Blood oxygen saturation 71%		

Figure 5. Private patient's record note

This private patient's record note presents all required information, in this case about "Kimberly Johnson". We can see all the diagnosis made, as well as the recorded vitals, which consists of the height, weight, BMI, Temperature, Pulse, Respiratory rate, blood pressure and blood oxygen saturation. We can also view the patient's latest visits and their statuses.

C OpenM	IRS			💄 admin	♥ Inpatient Ward +	Logout 🕞
🖀 🔸 johns	on, Kimberly > Visit	5				
Johnson surname Active Vi	n, Kimberly	Female 34 years (19.f	Feb.1980) Edit		Patient	ID (1004EX)
Visits	Contact Informa	ation			٥	Actions 👻
© 08 May 20 07:48 AM)	014 (active since	• Active Visit 🗿 Sta	arted at 08 May 2014	07:48 AM		Delete visit
V No diag	gnosis yet.	ن End Visit	😍 Visit Note	Admit to Inpatient	Sector Capture Vitals	
<b>O</b> 23 Oct 20	13 - 23 Oct 2013					
& Viral co	njunctivitis					
<b>O</b> 02 Apr 20	13 - 02 Apr 2013					
& Perinea during del	al laceration livery					
O 13 Mar 20	13 - 16 Mar 2013					
양 Jaundid	e					
© 27 Sep 20	12 - 27 Sep 2012					
& hookw	orm disease					

Figure 6. Overview of the last patient's visits

By clicking on one of the visits the user can edit the visit note, admit the patient to the inpatient ward, capture vitals or when the visit is over mark it ended.

On the left hand side the doctor has also the ability to see all of the past visits and happenings.

### OpenMRS

		💄 admin	🕈 Pharmacy 🗸	Logout 🕩
☆ > Susana, Bibi > Visit Note				
Susana, Bibi surname name Active Visit			Patient	1007GM
Visit Note				
	Date			
Provider Location	08/05/2014			
Super User • Pharmacy •	(dd/mm/yyyy)			
Add presumed or confirmed diagnosis (required):		Primary Diagnosis:		
Choose primary diagnosis first, then secondary diagnos	ies	Not chosen		
Clinical Note		Secondary Diagnose	s:	
		None		
	h			
Cancel				Save

Figure 7. Editing a visit note

The user has also the ability to take notes on the current visit. He can enter the primary diagnosis and the secondary diagnosis. Furthermore the provider of the note can be edited, as well as the location and the date.

			4	admin	♀ Inpatient Ward ╺	Logout 🕞
Johnson, Kimberly > Vi	isits					
ohnson, Kimberly name • Active Visit	/ Female 34 years	s (19.Feb.1980) Edit			Patier	nt ID 1004EX
Visits Contact Infor	mation				0	Actions 👻
O 08 May 2014 (active since 07:48 AM)	Started at 1	3 Mar 2013 03:45 PM - I	Finished at 16 Mar	2013 04:45 PI	М	
안 No diagnosis yet.	Attention!	These actions are for a	past visit:			
🕲 23 Oct 2013 - 23 Oct 2013	Encounters					
ဗ္ဗ Viral conjunctivitis	<b>⊙ 04:45 PM</b> 16 M	/lar 2013				
<b>O</b> 02 Apr 2013 - 02 Apr 2013	Dischar	ge by in Inpatient Wa	rd show details 🕨			
양 Perineal laceration during delivery	© 04:45 PM 13 h	Mar 2013		9° X		
<b>O</b> 13 Mar 2013 - 16 Mar 2013	Admiss	Ion by in Impetiant W	end chow datails b			
양 Jaundice		by in inpatient wa	ard show details #	J° ×		
<b>O</b> 27 Sep 2012 - 27 Sep 2012	O 04:45 PM 13 M	/lar 2013				
ဗ္ဗ hookworm disease	U. Visit No	by in Amani Hospin	tal hide details 🔻			
O 21 Sep 2012 - 21 Sep 2012	U			/ X		
🕑 Sexually Transmitted	Primary Diagno	osis (Presumed) Jaundi	ce [R17]			
Disease	Secondary Diag	gnosis (Confirmed) Oth	er Noninfectious [	Disorders of	Lymphatic Channels [l89.	8]
<b>O</b> 14 Mar 2012 - 14 Mar 2012	Text of encoun	ter note Excepteur sint	occaecat cupidata	at non proide	ent	
양 Sexually Transmitted Disease	© 04:42 PM 13 M	/lar 2013				
	Vitals	by in <b>Outpatient Clinic</b>	show details 🕨	ø x		

Figure 8. Another overview of the past visits

By clicking onto one of these visits the user can see a summary of the last visit, previous diagnosis and possible admissions and discharges. The user is also warned, that the current visit happened in the past and shall likely not be edited afterwards, which should prevent the user from unintended changes onto these records.

One can also view the private contact information for the specific patient by clicking on this tab in the upper part of the screen, which will then display the name, age, location and phone number and other contact details in case they are available.

		🚨 admin 🛛 🗣 Inpatient Ward 🗸 Logout (
Name	Check-In	Last Seen
Prashant Suvarna		Visit Note Outpatient Clinic @ 08.May.2014, 08:30:43
Kimberly Johnson		
	Name         Prashant Suvarna         Kimberly Johnson	Name     Check-In       Prashant Suvarna     Kimberly Johnson

Figure 9. Active visits listed

Back on the main menu the user can also view active visits directly without searching for a patient before. There, as assumed, are all currently happening visits listed with the patient ID, name and checkin date as well as "last seen" information which is composed of a location and a date to track this information unique. By clicking on the patients the name user is again directed to the patient record note.

Other options on the main menu are to register a new patient into the database, data fields such as name and family name as well as the gender and the birthdate are required. The option to enter an estimated age might come in useful for persons without any records. These information can later be edited on the patient's record note.

		۵	admin	💡 Inpatient Ward 🗸	Logout 🕩
🖀 🔸 Register a patient					
Register a patient					
Demographics	What's the patient's	. nomo?			
Name	what's the patient's	namer			
Gender	Given (required)	Family Name (require	ed)		
Birthdate					
Contact Info					
Confirm					

Figure 10. Registering a new patient

Back on the main screen, a third option is to register a new patient into the database. Data fields such as the name and family name as well as the gender and the birthdate are required. The option to enter an estimated age might come in useful for person without records.

One can also enter contact information to allow the easy contact to these patients.

The fourth option on the main menu is to capture the vitals of a patient, which can only be done once the patient is checked in. These vitals consists of, as previously seen, the patients pulse, weight,

temperature, height, respiratory rate, and blood oxygen saturation, systolic and diastolic blood pressure. Once entered, this information can also be accessed from the patient's record note.

The Style Guide options is probably no benefit for later use, this is probably a section for developers or admins and may not be available to default users. Colors, navigation element and the design might be changed there.

As well as the style guide the administrative center may not be available to users on final use. The administrator has the ability to change various settings regarding HL7 Messages, the Maintenance, Visits, the Users and their roles as well as an automatic ID Generation and Exchange Modules there.

All these information are stored on the server the web service is running on and can so be accessed from any computer all around the world. The User Interface is really slick and neat and provides all the needed information. By testing the service it felt fluid and intuitive and was easy to handle and navigate in. One drawback might definitely that the user interface seems not support multiple languages, at least not yet since all fields are English. But there's another big one patients cannot log themselves into this system and update their current vital signs, their doctor has to do that for them – so in situations where patients also need to be able to have a user account this system might not be the ideal choice.

Web Links Webpage: <u>http://openmrs.org/</u> Demo: <u>http://demo.openmrs.org/openmrs/login.htm</u>

## 4. Caisis

Caisis is an open source, web-based cancer management system that integrates patient care with research. Caisis is a derivative of the Italian word, Casus, which means "opportunity" or "event." Because that word was already trademarked, the creators decided to change the spelling slightly to Caisis, which carries the same meaning. This name also resembles an acronym for Cancer Information System.

Been downloaded by a lot of Institutions worldwide, the system promotes standards and collaborative research. Thanks to the Community that has being receiving constant Feedback, for over a decade, from collaborating Health centers, the Caisis Platform has been formed. The Community aims at high usability, and a clean vision when creating large datasets for researching cancer and patient care. The system is freely distributed and released under an Open Source License.

The Healthcare System Platform is written in ASP.NET/C# and uses Microsoft SQL Server. It is entirely web based, making it cross platform usable from the Users point of view. As an administrator it is possible to run the Platform on a Unix System (Linux or Mac Server), as long as the Mono Project is installed and configured for this use.

As in Open MRS demonstrated, there is also on the Web-Page of Caisis a Demo that can be used to get a glance at the Platform and its functions. Unfortunately the point of views, available in this Demo, are lesser that in Open MRS.

Welcome	SIS.	() Help	
Please enter demo: the password on the The application will aut	as the username and <b>password</b> as username right to begin. username tomatically log out after 120 minutes password		
Pease update your pas lyou need assistance application to contact	assword on your first login. Purpose:  Clinic a, use the help link from anywhere in the the system administrator.	al 💮 Research 🛞 Operations enter 🕨	
change your pass	word?	CAISIS	

Figure 11. Caisis Login Screen

To be able to enter and use the Platform, the User has to authenticate with his username and password, also choose which session type (listed as Purpose here) he wants to use.

In this footage we will be logging in as Clinical Purpose because of the Administrative rights, but on the Demo Page there are no Options for Developers/Admins.

								Disease View	All O
PATIENT LISTS			DATA ANALYSIS	MORE #				(	
Tasks 😴									
oday is Sunday, Septe	ember 14, 2014. Wh	at would you like to o	do?			📕 Patient Accrual by Data	set Patients entere	d in the past year.	
View a list of	f patients	1 v	liew/enter patient dat	a					
Print paper fi	loms	J E	inter an EForm			654		547 651 660 663 674	677
View a repor	rt	() N	tanage protocols			628 -	507 611	625 633	
Manage Spe	ecimens	<u>@</u> , p	rint education materi	ials		602 -	586 592		
Manage proj	jects	<b>.</b>	ustomize this page			576 - 550 - 5	9		
Recently Viewed Pa	atients select	a patient to view data					Pat	tients In This Dataset	
Name	MR	N	Last Vi	lewed		Patients for Today's Cli	nic select a patient	to view.	
Name test, test	<b>MR</b> 1234	IS6	Last Vi Today 4:2	lewed 24 AM		Patients for Today's Cli	nic select a patient	to view.	
Name test, test Smith, John	MR 1234 RCII	IN 156 05926	Last Vi Today 4/2 9/12/2014	lewed 14 AM		Patients for Today's Cli Clinic:	nic select a patient	to view	Clinics on Other Da
Name test, test Smith, John Doe, New	MR 1234 RCIE	IN 156 06926	Last VI Today 4:2 9/12/2014 9/12/2014	lewed 14 AM	Í	Patients for Today's Cli Clinic • Time N	nic select a patient	to view. MRN	Clinics on Other Da Visit Type
Name test, test Smith, John Doe, New chopra, sandhesh	MR 1234 RCIE 004	IN 156 D5926	Last VI Today 4:2 9/12/2014 9/12/2014 9/12/2014	lewed 14 AM 1	Í	Patients for Today's Cli Clinic • Time N	nic select a patient ame Select a clinic above	to view; MRN to view patient appointments.	Clinics on Other Da Visit Type
Name test, test Smith, John Doe, New chopra, sandhesh Surgery, Hada	MR 1234 RCIE 004 0000	N 156 15526	Last VI Today 4:2 9/12/2014 9/12/2014 9/12/2014 9/12/2014	lewed 14 AM 1 1	Í	Patients for Today's Cli Clinic • Time N	nic select a patient ame Select a clinic above	to view. MRN to view patient appointments.	Clinics on Other Dat Visit Type
Name test, test Smith, John Doe, New chopra, sandhesh Surgery, Hada Birth, John	MR 1234 RCIE 004 0000 3232	N 156 05926 0555666 12334	Last VI Today 4:2 9/12/2014 9/12/2014 9/12/2014 9/12/2014 9/12/2014	lewed 14 AM 1 1	ĺ	Patients for Today's Cil Clinic: • Time N	nic select a patient ame Select a clinic above ts select a report to	to view. MRN to view patient appointments. view.	Clinics on Other, Dat Visit Type
Name test, test Smith, John Doe, New Cchopra, sandhesh Surgery, Hada Birth, John Find More Patients	MR 1234 RCIE 004 9000 3232	N 156 155926 1555666 12334	Last VI Today 4:2 9/12/2014 9/12/2014 9/12/2014 9/12/2014	ewed 24 AM		Patients for Today's Cli Clinic: Time N Time N Recently Viewed Report	nic select a patient ame Select a clinic above ts select a report to	to view. MRN to view patient appointments. view.	Clinics on Other Date Visit Type
Name test, test Smith, John Doe, New chopra, sandhesh Surgery, Hada Birth, John Find More Patients	MR 1234 RCIE 004 9000 3232	N 1565 15926 1595666 122334	Last VI Today 4:2 9/12/2014 9/12/2014 9/12/2014 9/12/2014	ewed 4 AM 1		Patients for Today's Cli Cinic: • Time N • Recently Viewed Report Name	nic select a patient ame Select a clinic above ts select a report to aritment	to view. MRN to view patient appointments. View. Last Viewed	Clinics on Other Dat Visit Type
Name test, test Smith, John Doe, New chopra, sandhesh Surgery, Hada Birth, John Find More Patients Recently Viewed Ef	MR 1234 RCII 004 0000 9232 Norms select a	N 1556 1555666 12334 In ctorm to view.	Last VI Today 4:2 9/12/2014 9/12/2014 9/12/2014 9/12/2014	ewed 4 AM 1 1		Patients for Today's Cli Clinic:  Time N Recently Viewed Report Name Specimen View Available Sp	nic select a patient ame Select a clinic above ts select a report to ecimens	to view. MRN to view patient appointments. View. Last Viewed 9/12/2014 0/12/2014	Clinics on Other Dat Visit Type
Name test, test Smith, John Doe, New chopra, sandhesh Surgery, Hada Birth, John Find More Patients Recently Viewed Ef	MR 1234 RCII 004 9000 3233 forms	N 155 155 155 155 155 155 155 155 155 15	Last VI Today 4 2 9/12/2014 9/12/2014 9/12/2014 9/12/2014	ewed 4 AAM		Patients for Today's Cli Clinic:  Time N Recently Viewed Report Name Specmen, View Available Sp Liver Dataset	nic select a patient ame Select a clinic above ts select a report to ecimens	to view.  MRN to view patient appointments.  view.  Last Viewed 9/12/2014 9/12/2014 9/12/2014	Ginics on Other Dat Visit Type
Name test, test Smith, John Doe, New chopra, sandhesh Surgery, Hada Birth, John Find More Patients Recently Viewed Ef Name	MR 1234 RCII 004 0000 3233 select a MRN	N 156 15555666 122334 In eform to view. EForm	Last VI Today 42 9/12/2014 9/12/2014 9/12/2014 9/12/2014 9/12/2014	eved AAM		Patients for Today's Cli Clinic: • Time N • Recently Viewed Report Name Specimen, View Available Sp Liver Dataset Patient Summar Report	nic select a patient ame Select a clinic above ts select a report to ecimens	to view.  NRN  to view patient appointments.  view.  Last Viewed 9/12/2014 9/12/2014 9/12/2014	Clinics on Other Dat Visit Type
Name test test Smith, John Doe, New chopra, sandhesh Surgery, Hada Birth, John Find Mare Patients Recently Viewed Eff Name test, test	MR 1234 RCIE 004 0000 3232 Select a MRN 123496	N 665 05525 22334 at efform to view. EForm GU Pros FU	Last VI Today 42 9/12/2014 9/12/2014 9/12/2014 9/12/2014 9/12/2014 Updated Today 4/29 AM	ewed A AM Status Status		Patients for Today's Cli Clinic:  Time N Recently Viewed Report Name Specimen View Available Sp Live Ortakset Patient Summary Report More Reports	nic select a patient ame Select a clinic above ts select a report to ecimens	to view.  NRN to view patient appointments.  View:  Last Viewed 9/12/2014 9/12/2014 9/12/2014	Cinics on Other Dat Visit Type
Name test test Smith, John Doe. New chopra, sandhesh Suigery, Hada Birth, John Find Mare Patients Recently Viewed Ef Name lest test Smith, John	MR 1234 RCIE 0004 0000 3232 forms select a MRN 123496 RCID5926	N 1555 155	Last VI Today 42 9/12/2014 9/12/2014 9/12/2014 9/12/2014 Updated Today 4/29 AM 9/12/2014	eved 4 AM 4 5 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Patients for Today's Cli Clinic:  Time N Recently Viewed Report Name Specimen View Available Sp Live Ortakset Patient Summary Report More Reports	nic select a patient ame Select a clinic above ts select a report to ecimens	to view.  NRN to view patient appointments.  View.  Last Viewed 9/12/2014 9/12/2014 9/12/2014	Cinics on Other Dat Visit Type
Name test test Smith, John Doe, New Chopra, sandhesh Surgery, Hada Birth, John Fand More Pastents Recently Viewed Eff Name test, test Smith, John Doe, New	1233 Roti 004 0000 3232 forms select a MRN 123496 ROID5526	N 666 555255 5555666 22334 Reform to view GU Pros FU Portine Surgery Efform Colorectal Surgery Efform	Last VI Today 42 9/12/2014 9/12/2014 9/12/2014 9/12/2014 Updated Today 4/29 AM 9/12/2014	A AM		Patients for Today's Cli Clinic:  Time N Recently Viewed Report Name Specimen View Available Sp Liver Dataiet Patient Summary Report Mere Reports	nic select a patient ame Select a clinic above ts select a report to ecimens.	to view.  New.  Last Viewed 9/12/2014 9/12/2014 9/12/2014 9/12/2014	Cirics on Other Dat Visit Type

Figure 12. Welcome Page in Caisis

First of all the User is logged into the "Home Page", where he has an Overview of his activities, meetings and a lot of other Information. On this page the User can make use of the listed common Tasks or navigate through the tabs, and filter out the actions he wants to use. On the "Home Page" the Main Window the actual Date is displayed to the User and fast access to Viewed Patients, Viewed Eforms, Pending Eforms, todays patients, viewed report, patients accrual by datasets, and a lot of other common tasks. For example he can view a list of patients, enter patient data, print paper forms, enter an EForm, view a report, manage protocols, manage specimens, print education materials, manage projects and at last customize the Start Page. On the top right corner the User can see his name, use the Help-Button and Log-out. Other actions can be performed like Filtering the entire Database search Results to a Disease. On top in the mid task bar the User always gets the Name-lastname of the Selected Patient and a DOB rate. Also its search function can be used like a search Engine with the "Find A Patient - Filter" giving the user a lot of opportunities to manipulate the search results.

•		Patients	Encounters	Procedures	Therapies	Diagnostics	Outcomes	Workflows			
							R Medications 1	or ANB			<u>(1</u> )
View: List	All		PSA ALABS								
Date	Variable	Value	Quality					Start Date	12/11/2012	(( <b>R</b> )	
PreTx	X diabetes mellitus		OUT						10/11/0010		
Pretx	X Hypertension		OUT						12/11/2012		
pretx	K Flank Pain	1 Cousin Bladder	001					Stop Date	12/11/2012		
	Family Hx	Cancer									
	Encounter	2nd Screening							12/11/2012		
	Cystectomy	Needle Biopsy	RR					Туре	Anticoagulants		
	<ul> <li>Inguinal Node</li> <li>Dissection</li> </ul>		OUT								
12-28-2011	O Cystectomy		RR					Medication	Aspirin		
12-11-2012	Aspirin										
06-27-2013	Encounter	1st SCreening New	v STD					Dose			
	Physical Exam		STD					Total Dore			
	Rectal Exam	Unknown	STD					Fotal Dobe			
	Bimanual Exam		STD					Units (i.e. mg)		•	
	Review Of Systems		STD								
06-28-2013	4. Specimen Accession							Route		•	
07-24-2013	* Encounter	2nd Screening						Schedule	1		
07-24-2014	Encounter							Indication			
	Review Of							nocason			
09-11-2014	CDEAT	1.9	OUT							69	
00-11-2014	CREAT	1.0	001					Notes			
								110103			
										<u></u>	
								Data Source			
								Data Quality		•	
								Data Quality		•	

Figure 13. Overview of the patient's data

Highlighting the Patients Data Tab we can see various vital Information about the Patient that might be very interesting for the User. On the left panel a Table with valuable Information about Exams and Health Checkups, Results as upcoming Exams, exists. The Exams, Results and notes are listed from previously taken to upcoming. Information about the Illness, the Date encounters occurred, the Date medication was taken and the amount of it, Date and Name of surgery, etc. is given. If the User wants to edit this Information, or maybe export it, he has to highlight an Event (ex. 12-11-2012 Aspirin) and then he can manipulate the Information in the right Tab. If the User clicks on the Exam or Checkup he can visit the Node and edit the Attributes of the Node. For example Medication can be edited for the Doses that has to be taken by the User, or the Units he has to consume. The Schedule and the start and end date. Highlighting an Exam the editable attributes if the Node are more. A Date can be inserted, a type, the name of the Physician, Nurse and the Status. Also many results and valuable Information like the Height, BMI and Weight of the patient can be edited.

Add a	a New Patient		🤣 PRINT	8
4.	Add a New Patient			
	Please enter all available information for this patient. I	Fields named in <b>red</b> are required.		
	First	Address 1		01
	Middle	Address 2		
	Last	City		
	MRN	State		
	DOB	Postal Code		
	Gender	Country		114
	Race	Notes	3	
CI.	Contact Status 🔹 🔻			
				- 8
	cancel	add this patient to the database		
	N			aintr
				- 11
_				
				ewe
SE				14
				14

Figure 14. Registering a new patient in Caisis

New Patients can easily been added to the Database by clicking the "Common Tasks" drop-down Menu and highlighting the "Add new patient" Option. As in the Picture seen there are a lot of Options available, to enter Information about the Patient. Only Last Name and MRN are required Information, as for the Developer those two values are viral and important, for the Database. Values as First- "Middlename, Date of Birth, Gender, Race, Contact Status, Addresses and Notes are not required for making a record.

Of course we did some testing and came to the conclusion that the MRN is a value that has to be unique. If not so, the Platform prompts the User that a recorded Patient already exists with the given MRN. The other way, the Last name has to be a value unlike null. It appears that there can be more "PatientsFachstudie" in the Database with different MRNs', but different "PatientsFachstudie1" and "PatientsFachstudie2" with the same MRN cannot exist. Searching for the Patients can be done through the "Find a Patient" text field on top of the Site, or on clicking the "Patients List" Tab.

ck a record below to view data	for that patient.		Displaying 0 to 200 of 677 patients Nex
Name	D.O.B.	MRN	Comments
			PROTOCOL-PATIENT
a			
AA			
ali			
ANB			
Datpatient			
Reza			
S			
test			Protocol-Patient   Participant ID: 100017
#1# #1#		#1#	Protocol-Patient   Participant ID: 100024
#2# #2#		#2#	Protocol-Patient   Participant ID: 100025
???? ????	14042013	9100	
777 77777	1361	77777	
77777 77777		89767263	
22222 22222		100537	
????? ?apasta????	05/11/1988	1452369852145	?sd asdsaasdas asdassdsad asdsad sadsadasdad asd sadasd asd d dsd asddsasadsad asdasdasd asdasdasd asd asd asdasd asd asd asd asd
121212 1121212		1121212	
12		fgh567	
John 123	11/16/1970	AK47	none   Participant ID: 100030
1925 Tu St 1925 Tu St	1925 Tu St	Unit #290	

#### Figure 15. Overview of all patients

At this time the only available Display Language on the Caisis Plattform is english, but as it is a Open Source Project (GPL General Public License) there shouldn't be a Problem to install Language Packs manually. The Official Statement of Caisis Developers is that Language expansions will come with time, as the project matures.

### Minimum Requirements for the Web Server Are: Web Server

- Windows Server 2000 and above
- IIS 6 and above
- Microsoft .NET Framework 3.5/4.0

### Database

- Microsoft's SQL Server 2008++
- To estimate DB size, the following formula may be used:

- [(24.7 x # Patients)/1024] + 10MB = Total Database Size (MB)
- Computed Average: 24.7 KB/Patient
- Empty Database Size: 10.0 MB
- 1MB = 1024 KB
- 10 % of MDF file (equals the size of the log file)

Web Links Webpage: <u>http://www.caisis.org/</u> Demo: <u>http://caisis.org/demo/Login.aspx</u>

## 5. NOSH

Nosh (New Open Source Health) is another Open Source Health Charting System released under the GNU AFFERO GENERAL PUBLIC LICENSE which aims to let medical providers have access to an "intuitive, world-class electronic health record for minimal cost". The project is developed by Michael Chen, a family physician from Portland, Oregon. The project is mainly written in PHP with JavaScript.

The Live Demonstration offers four abilities to log into the system either as provider, assistant, billing and patient, so we can actually use the system as patient as well which might be a huge advantage.

Heername		
Osername.		
Password:		
Organization/Pr	actice:	
Demo Clinic	~	

Figure 16. Login Screen for the Nosh Platform

The login screen is minimalistic but still offers a modern design, where the user can enter his username, password and the organization he wants to log into.

## 4.1 Provider Account

Fasks Messaging Schedule Financial Office Configure	Theme: Redmond	Version 1.8.2   Demo Provider, MD   Jun 16, 2014 Logout
Nosh Search patient and then select to open the chart. + New Pati	ent	
Welcome Demo Provider, MD.		
What has a sour first time logging in, you should change your password.		
Update your user information		
You have 0 messages to view.		
You have 0 new documents from the fax or scanner to view.		
You have 0 pending appointments today.		
You have 19 unsigned messages and encounters.		
You have 0 reminders.		
You have 0 test results to reconcile.		
You have 0 new bills to process and send.		

Figure 17. Welcome Screen for a provider in NOSH

As we are logged in as a provider we are greeted by a welcome page which shows us new unread messages, new documents, appointments or reminders.

Tasks Messaging Sche	Messages	D   Jun 16, 2014 Logout
Nach Search	- Practice Messaging	Close Chan
i wan	+ New Message	
Welcome Demo Provic	Inbox	
If this is your first t	Date →         From         Subject	
Update your user	Drafts	
You have 0 mess	Sent Messages	
You have 0 <u>new d</u>	► Scans	
You have 0 pendir	Address Book	
You have 19 <u>unsic</u>		
You have 0 remine		
You have 0 test re		
You have 0 new b		

Figure 18. Message Overview in NOSH

By clicking the message item on the top content bar we access the message menu, which is not opened as a new webpage or tab but instead as window on top of the welcome screen. Here we can send messages; import done scans or one can manage the address book. By clicking onto the new message item another window appears which looks similar to mail clients, there we have the ability to enter a subject the receiver of the message or copies of it, additionally to mails we have the ability to enter the concerning patient which is optional as a second subject.

<u>Tasks</u> <u>Messac</u>	Scher	lule									_			5, 2014 Logout
nach	0		Jur	ie 201	14		0	0 0	today	Jur	2 — 6 2014	1	week day	Close Chart
wan	Su	Мо	Tu	We	Th	Fr	Sa		Mon 6/2	Tue G/3	Wed 6/4	Thu 6/5	Fri 6/6	<u>^</u>
	1	2	3	4	5	6	7	all-day						
Welcome Dei	8	9	10	11	12	13	14	8am					~	
If this is	15	16 23	17	18 25		Sche	dule a	in Appoir	itment					
	29	30					Sta	art Date:	06/03/2014					
Update							Sta	art Time:	08:30AM					
You ha	Provid	er:												
	Den	10 Pro	ovide	r, MD				Patient:	Teste L, Teste F (D	DOB: 11/01/1989)	ID: 4)			
You na							Vi	ait Type:	Acute 🔻					
You ha									1					
You ha								Reason:	10					
												10		
You ha														
You ha														
You ha														
											· ── Sav	e 🗙 Cancel		
								-						

Figure 19. Calendar and schedule option for appointments

The option schedule opens a calendar; by clicking onto any of the free slots we can schedule a new appointment. By default there are five visit types available: acute, followup, surgical, reser and FOC. The patient field has some sort of auto complete so the user does not need to keep all the patients and their data in his mind. On the first sight there might be no option to change the duration of such an appointment, but after creating it one can drag the end to the field the user desires to. The system allows the user to have multiple appointments at the same time. The single appointments can be dragged and dropped from one time or day to another one.

sks Messac Schedule							×
0 June 2014 C	00	today	<mark>J</mark> un	2 — 6 2014	1	week day	ľ
Su Mo Tu We Th Fr Sa		Моп 6/2	Tue 6/3	Wed 6/4	Thu 6/5	Fri 6/6	- 1
1 2 3 4 5 6	7 all-day						
/elcome Dei 8 9 10 11 12 13 1	4 Sam					*	
15 16 17 18 19 20 2	1						
If this is 22 23 24 23 26 27 2 29 30	5		8:30 - 9:00 Teste L, Teste F				
Vpdate	9am		(DOB: = )				
Provider:							
You ha	10am						- 1
You ha							- 1
							- 1
You ha	11am						- 1
You ha							- 1
							- 1
You ha	12nm						
You ha	Party						
8888							
	Team						
	1 pm						

Figure 20. Example appointment in the calendar

Tasks Messac	Sche	dule																				×	5, 201	4 <u>Logo</u>	ut
noch	0		Jun	ie 201	14		0	0 0	tod	lay		J	un 2	- (	5 201	4			wee	k da	y	Î	× c	lose Cha	art
· ware	Su	Mo	Tu	We	Th	Fr	Sa		Moi	n 6/2		Tue 6/	3	We	d 6/4		Thu	6/5	Fri 6/	6					
Welcome Der	1 8	2 9	3 10	4	5 12	6 13	7 14	all-day					_												
	15 22	16 23	17 24	18 25	s	che	dule a	ап Арроіі	ntment	1						16									
	29	30			E' A	vent ppo	ID: 2 intme	6   Patien nt added	ID: 4 by Demo	o Provider,	MD	on 201	14-06-1	5 16:3	17:42										
You ha	Provid	er:						Status:	Pendir	ng			•												
You ha	Der	no Pro	ovide	r, MD			Sta	art Date:	06/03/2	2014															
You ha							Sta	art Time:	08:30AM	4															
You ha								Patient:	Teste L,	Teste F (DC	0 <mark>6: 1</mark> 1	1/01/19	89) (ID: 4	)											
You ha							Vis	sit Type:	Acute	•															
You ha								Reason:																	
You ha																		6							
(0000)																			-						
										🖪 Save		🍃 Оре	en Chai	rt	Dele	te	×	Cancel							
																						*			

Figure 21. Scheduling an appointment

By clicking back onto the appointment we have now the possibility to delete it or open the chart.

Search patient and then select to.	open the chart. + New Patient	Active Patient Chart	t: Teste F Teste	└ ※	<u>Clos</u>			
evere	Demographics							
Chart for (ID: 4)	🖪 Save 📑 Save and Clos	e × Cancel	a Insurance	Register for Patient Portal				
Nickname: Date of Birth: November 1st, 1989 Age:	<ul> <li>Name and Identity</li> </ul>							
Gender: Last Encounter: No previous visits. Next Appointment: None	Last Name:	First Name:		Nickname:				
	Teste L	Teste F						
Crowth Charts	Middle Name:	Title:		Date of Birth:				
E CIOWIT CHAILS				11/01/1989				
Fdit Remographics	Gender:	SSN:		Race:				
		* ]						
V Edit 🔯 Issues	Marital Status:	Spouse/Part	ner Name:	Employer:				
🖌 Edit 🚀 Medications		•						
	Ethnicity:	Caregiver(s)	a: -	Status:				
/ Edit 🤐 Supplements				Active				
Edit / Immunizations	Referred By:	Preferred La	nguage:					
Edit 🛕 Allergies								
🗸 Edit 🔒 Alerts	▶ Contact							
	Guardian							
	4 Other							

Figure 22. Demographics overview and edit option

This gives us a lot of information about the patient, there may be even more information or fields that needed but fortunately they do not need to be filled. On the left hand side we have also the ability to view the demographics, issues, medications, supplements and so one. This allows us either to view or to update information on the patient record note.

Search patient and then selec	t to open the chart + New Patient	preuve radent chart. reste	I TOSTO E	X Close						
And and A	Medications									
Ochart for (ID: 4)	Medications - Click on the Da	te Active column to get past pro	escriptions for the medicatio	n. 💿						
🖉 Edit 🔒 Demographics	Date Active 🖕 Due Date	Medication	Dosage Uni	t SIG Frequency						
a Edit 🕅 Iccupe	Add Medication									
V Eur	Medication:		Dosage:	Unit						
Edit Medications			)							
Edit and View Details	Sig:	Route:	Frequency:							
		PO	·]							
	Special Instructions:		Reason:							
	Date áctive:		1							
	06/16/2014									
🖉 Edit 🛛 🕰 Supplements										
/ Edit / Immunizations										
Allerries										
Z Lutt A Anotytes				Save Cance						
a Edit										



This can be done by e.g. clicking onto medications, then edit and view details and add medication. So we have to enter the medication the signature, the dosage and unit, as well as special instructions of the frequency the patient needs to take his medication.

Back on the welcome page we can register and add a new patient to the database by clicking the new patient button and then enter the last, first name, date of birth and the gender of the patient. These fields are required, the other ones, listed in the chart section are optional and might be filled there.

Billed Encounters Waiting to be Sub	mitted	•
Date 🤤 🛛 Status	Batch Type Last Name First Name	Chief Complaint
φ	la ≪a Page 1 of 0 ⇒ ⊨i 10 ▼	No records to view
🚊 Create Batched Print Image	🚊 Create Batched HCFA-1500 - Editable 🖉 🚇 Cr	eate Batched HCFA-1500
Billed Encounters that have been Pr	ocessed	୍
Resubmit Bill     ✓ Make Pa	yment to Encounter	
Outstanding Balances		
Reports		

Figure 24. Financial section in NOSH

By choosing the financial section we have the ability to create bills, add outstanding balances or reports.

Tasks Messac	Office Tools		5, 2014 Logout
nach	Vaccine Inventory		Close Chart
rwan	Vaccine Inventory	•	
Welcome Der	Date Purchased Vaccine 🖕	Quantity	
	φ asu φ e e Page 1 of 1 ⇒ ⇒ 10 ▼	View 1 - 1 of 1	
Update	+ Add 💉 Edit 🗶 Inactivate 🝵 Delete		
You he	Inactive Vaccine Inventory	0	
You ha	* Reactivate		
You ha	Vaccine Temperatures		
You ha	Supplements Inventory		
A You ha	Queries and Reports		
	> Export Data		
You ha			
You ha			

Figure 25. Office Tools to handle the inventory and import and exports of files in NOSH

By choosing the Office item, we have different options to edit the vaccine inventory or the temperature. One can also see queries and reports or export the office data.

The configure section allows us to set divers settings for the HPI Forms, Situation Forms and different orders.

Despite logging into the system as the provider nosh also offers the ability to login as a assistant. The start page nearly looks the same. We have a welcome message and the start page with notifications about received but not yet read messages, documents or reminders. In comparison to the provider account there is only the appointments field missing.



On the top we have also the menu bar which includes tasks, messaging, scheduling and so on.

Figure 26. An appointment in the view of an assistant

The scheduling calendar looks the same as being logged in as provider, the assistant can choose the provider on the bottom left hand side and see the corresponding calendar and reschedule his appointments.

## 4.3 Patient Account

OSH ChartingSystem Personal Health Record   <u>Tasks</u>	Theme: Redmond   Version 1.8.3   Child Boy   Jul 16, 2014 Logout
Welcome Child Boy.	
If this is your first time logging in, you should <u>change your password.</u>	Your active medical issues.
Update your demographic and insurance information	Your active medication list.
Schedule an appointment	Your active supplement list.
View your messages.	Your immunization records.
Fill out forms.	Your allergy list.
Your patient instructions.	Your personal health record.
	View growth charts.

Figure 27. Welcome Page as patient (here: Child Boy)

Another option is to log in as a patient, which can come in quite handy. The start page finally looks really different compared to what we saw from the providers and assistants point of view.

On the start page we can update our demographic and insurance information or schedule an appointment. We have also the ability to view our messages, find patient instructions or fill out forms. We can also have a look at our active medical issues as well as medication and supplement list. Also we can see our immunization records and an allergy list as well as our personal health record and a growth charts.

		Ju	ly 201	4		0	0 0	today	Jul 14	— 18 201	4	week day	î
Su	Мо	Tu	We	Th	Fr	Sa		Mon 7/14	Tue 7/15	Wed 7/16	Thu 7/17	Fri 7/18	
		1	2	3	4	5	all-day				-		
6	7	8	9	10	11	12	Page						
13	14	15	16	17	18	19	oam						
20	21	22	23	24	25	26							
27	28	29	30	31									
							9am				9:00 - 10:15 Child, Boy (DOB:		
n app rovid Den Step 2 ne sc	pointm er: no Pro 2: Clic hedul	ient: wider, k on a e.	MD n oper	✓ n time	e slot	on	10am				-		
here ppoir ppoir	can b ntment ntment	e no o s with	verlap an e>	ping cisting	9		11am						
		otified	l if the	re is	a pro	blem	10000						
′ou w ⁄ith y	our ap	pointr	nent re	eques	st.		12pm						



Scheduling an appointment as patient works the same as scheduling an appointment as provider or assistant. On the left hand side the patient can choose the provider and can read the instructions on how to reschedule an appointment on their own. Nosh will notify the patient if there is a problem with the appointment in case it cannot be rescheduled according to the patient wishes.

Forms and instructions cannot be added as patient instead viewed only. Once the provider has added a form the patient should be able to fill out this form from his account.

Issues		
Issues		0
Date Active 🖕	Issue	
2014-05-19	ADHD, anxiety	
¢	I < < Page 1 of 1 >> > I 10 y	View 1 - 1 of 1
Inactive Issues		•

#### Figure 29. Listed issues

By choosing the issue field these are displayed to the user, issues can also not be added as user but only viewed. The same applies to the other fields, where the user can keep track of his medical history and view past events, but he is not able to edit or change any of these entries.

Web Links Webpage: <u>http://www.noshchartingsystem.com/</u> Demo: <u>http://demo.noshchartingsystem.com:444/nosh</u>

# 6. Microsoft HealthVault

Microsoft HealthVault is in comparison to the previous clinic management systems no open source platform but we can still test it by creating a Microsoft account.

On the first page HealthVault advertises itself with the features it provides, it can give us the ability to organize our family's health information and be better prepared for doctor visits and unexpected emergencies. Furthermore we can create a more complete picture of our health, with us ourselves at the center and last but not least achieve our fitness goals. [http://goo.gl/CO3FTm, 2014-07-15] Access to the health data can be shared so that one can change the entered values.

≤ HealthVault	+ Add - Print Export		User~ <b>?</b>
User   ~	current all		MANAGE TILES
Home	Let's get started	×	
Basic profile	Welcome, b14ckj4ck. Here are a few tips to help you get started taking control of your health information.		
Health views	1. Enter your basic stats. You could start 🛛 ൽ 2. Fill out your <u>emergency profile</u> . In just		
Measurements	a few minutes, you'll have printable,		
Health history	sharable emergency health info.		
<ul> <li>Documents</li> </ul>	😺 o 3. Connect your health apps & devices to 🛛 🚑 4. Learn how to get your medical		
Apps & devices	keep all your health info in one place.		
Sharing Record history			
Record history			
	Measurements		
	Weight ···· 🗗 Blood pressure	•••	
	● Food & drink ···· 4 Blood glucose	•••	
	🐨 Exercise 🚥 🖤 Cholesterol	•••	
	∱ Steps ····		

After login in we are welcome by the start page and a brief introduction.

Figure 30. MS HealtVault after logging in

The first steps are quite simple we can enter our weight either in "lbs" or in "kg". Furthermore one needs to enter the date of the record, so we can keep track of our possible weight fluctuations. After entering our weight we shall enter our height, either in feet and inch or in, as we use it, centimeters. As seen on the weight page we need to enter a date as well, to keep track of changes which might not be needed for full-grown patients. The Import buttons gives one the ability to upload a comma separated spreadsheet file containing the suitable data.

## Weight

SAVE 🖳 SA	VE & ADD ANOTHER	X CANCEL
Weight *		
80	kg 🗸	
Date * ex: 7/16/2014	Time ex: 12:35 AM	
7/16/2014		
+ Add a note		

Figure 31. Editing a person's weight in MS HealthVault

🚰 HealthVault	(+) Add ~			
User	Emergency profile			
Home	Print	Share	Prepare	
Basic profile				
<ul> <li>Health views</li> </ul>		HealthVault		
Emergency profile				
Weight management				
Measurements	Print wallet card	et an	Prost Processing and Provide State	
Health history	Print profile sheet	snare emergency profile	ring emergency apps	
Documents				
Apps & devices	User			
Sharing	Date of birth: 2/13/1994			
Record history	Allergies			Add
	You don't have anything listed here yet.			
	Conditions			Add
	You don't have anything listed here yet.			
	Current medications & su	upplements		Add
	You don't have anything listed here yet.			
	Emergency or provider c	ontacts		Add
	You don't have anything listed here yet.			
	Medical devices			Add
	You don't have anything listed here yet.			-

Figure 32. Emergency profile in MS HealthVault

After entering our height and weight the "Let's get started" guide advises us to complete our emergency profile. Several allergies, conditions or medical devices can be listed here. By choosing to add a new allergy we have a lot of options to customize the record. We, of course, have to enter the name of our allergy and can also enter the reaction where we can choose from a lot of different options (approx. 80 Values) containing blood infection, cough, diarrhea, fatigue, fast breathing and many many more. Type does not offer that much options, we can choose from environmental, animal, food, medication or plant. We can but do not have to enter some treatment info, we can enter the treatment provider including his full contact info, we also enter the treatment and have to answer the question whether the treatment did stop the reaction, we can choose from yes, no or don't know. One can also enter an allergen code and a note to even further descripe this allergy.

Similar to the allergt record we can enter a new condition give it a name and select a status, the options are "Comes and goes", "is gone" and "currently has this". The user can also enter the start and end date and how it ended (ex: recoverd) and of course enter even more notes.

#### Allergy

Asthma		
Reaction		
blood infection		~
Туре		
environmental		~
First observed		
ex: 7/16/2014		
7/31/2014		
<ul> <li>Hide treatment info</li> </ul>		
Treatment provider		
Doctor		
Show contact info		
Treatment		
Does treatment stop the r	eaction? *	
Don't know		~
Allergen code		
A10DFS		
Note		

We can enter current medications and supplementes as well as emergency or prociver contacts and medical devices as we entered the allergies and the conditions. The doctor entered in the allergies section is automatically added in the section "emergency or provider contacts".

Measurements
 Blood glucose
 Blood pressure
 Cholesterol
 Exercise
 Food & drink
 Height 1
 Lab test results
 Peak flow
 Weight 1

Our emergency profile also provides the options to print a wallet card the profile sheet or to share our emergency profile. Another option is to find emergency apps.

On the left hand side we have a brief overview of our previous measurements. We can enter new data for the blood glucose, our blood pressure the cholesterol value. We can also add exercises we are currenlty doing such as swimming or walking. We can enter our food & drinks, our height and different lab test results. We can also add a peak flow and keep track of our height history which offers us also a nice chart overview containing our past data.

Figure 34. List of several provided measurements

Below our measurements we have a brief health history

overview which consist of different values such as allergies, appointment and conditions we entered before. By cklicking on the corresponding field we see the history over our past data with

Last there are some options in the document section to import different HL7 file types into the system. Microsoft HealthVault currently supports the Continuity of Care Document (CCD) and Continuity of Care Record (CCR).

We can also enter apps and devices which keep track of our health values. We can also look at a the record history and can we changes made in a specified period of time.

' H	eal	th	hist	tory	

Allergy 1

- Appointment Condition Emergency or provider contact 1 Family history
- , ,
- Immunization
- Insurance plan
- Medical device
- Medication
- Procedure

Figure 35. Health History in MS HealthVault

Date	Action	Туре	Changed by	Арр	Summary	Details
7/16/2014 1:05:31 AM	Changed	Application-Specific Information	b14ckj4ck	Microsoft HealthVault	HealthVault Homepage Tile Settings	۲
7/16/2014 12:51:06 AM	Created new entry	Emergency or Provider Contact	b14ckj4ck	Microsoft HealthVault	Doctor (Provider)	۲
7/16/2014 12:51:05 AM	Created new entry	Allergy	b14ckj4ck	Microsoft HealthVault	Asthma	۲
7/16/2014 12:38:52 AM	Created new entry	Height Measurement	b14ckj4ck	Microsoft HealthVault	193 cm	۲
7/16/2014 12:38:43 AM	Created new entry	Weight Measurement	b14ckj4ck	Microsoft HealthVault	80 kg	۲
7/16/2014 12:31:44 AM	Created new entry	Application-Specific Information	b14ckj4ck	Microsoft HealthVault	HealthVault Homepage Tile Settings	۲
7/16/2014 12:31:44 AM	Created new entry	Basic Demographic Information	b14ckj4ck	Microsoft HealthVault	male; Born 1994	۲
7/16/2014 12:31:43 AM	Created new entry	Personal Demographic Information	b14ckj4ck	Microsoft HealthVault	b14ckj4ck	۲
7/16/2014 12:31:43 AM	Created new entry	Personal Contact Information	b14ckj4ck	Microsoft HealthVault	b14ckj4ck@hotmail.de (Primary)	۲

Figure 36. Look at the records history

≤ HealthVault	🕀 Add 🗸 Print Export	User 🗸	?
User   v	Measurements		^
Home Basic profile Health views Measurements Health history	Weight o 176.4 lbs 7/16/2014		
<ul> <li>Documents</li> <li>Apps &amp; devices</li> </ul>	● Food & drink ···· ♦ Blood glucose ····		
Sharing Record history	🐨 Exercise 🖤 Cholesterol		
	↑ Steps ····		
	Current health		
	Allergies ••• Asthma fast breathing		
	Lo Upcoming appointments ····		
	Medications ····		
	Conditions ····		
	/ Immunizations ····		
	Contacts & insurance		
	Emergency or provider contact •••• Doctor		
	😰 Insurance plan 🛛 🚥		~

Figure 37. The User's home page in MS HealthVault

Back on the main and start page we have a brief overview of either all or the current data, containing our weight and much more of our entered data.

As of our knowledge there is nothing like a special doctor or physician account, the data must be shared with him, so he can check our entered data. The advantage might be that we are actually in control after deciding to change our doctor our old one can no longer access our data (in case we remove his authorization), on the other hand these must be entered manually what might be confusing for many users. We would prefer dedicated doctor or physician accounts and belief this would make the platform easier to use and understand.

Despite being not a HL7 standard Microsoft HealthVault can still import HL7 file types, therefore we added and tested it here. This platform is neatly arranged and fits well with all the other microsoft services. This can either be an advantage or a huge disadvantage. A large problem might be that the data is stored on the Microsoft servers all around the world, due to the latest NSA scandals this might not be ideal. Different people working and supporting the HL7-Standard claim the "The Crisis in E-Health Standards" needs to be stopped and this should not be done by "quasi-governmental committees" [http://goo.gl/7HEZuY, 2014-07-15]. Microsoft HealthVault provides some good ideas such as adding devices which keep automatically track of the patient's vital signs and the ability to always look at the vital signs of older related persons or of one's kids but in the end might not be used due to a limited access, since it is not an open-source project, and the fact we do not have control over the data. HealthVault interacts strongly with the corresponding API which might be regarded as another disadvantage since this is a proprietary Microsoft API it might be available across many devices but be rather Microsoft specific. On the other hand by using these APIs keeping track, changing or adding information has been made really easy.

#### Web Links

Webpage: https://www.healthvault.com/

# 7. OpenEMR

OpenEMR is an electronic health record (EMR) and medical practice management software. It is written in PHP which makes it more or less platform independent as many platforms (Windows, Linux, Max OS X, ...) run PHP. The Project was created with the aim to give the users of EMR software a free and feature rich software where they have the complete control over the system and the patient's data. It is licensed under the GNU General Public License and therefore freely available for everyone. It also has an ONC Complete Ambulatory EHR Certification.

## 6.1 Doctor Account

The first thing to see when opening the web frontend to OpenEMR is a login box where the user has to provide a user name and a password, he can also choose from about 20 languages, any other language can be added and translated with a google docs spreadsheet maintained by the community. The OpenEMR demo gives the opportunity to login as an admin, a physician, a clinician, an accountant

Login	<b>OpenEMR</b>	
	Username: Password: Language: Default - English (Standard) Login V4.11   Admowledgments, Libensing and Certification	

Figure 38. Login Screen in OpenEMR

http://www.open-emr.org/wiki/images/thumb/5/57/OpenEMR-Login\_4\_1\_1.png/800px-OpenEMR-Login\_4\_1\_1.png

and a receptionist, where a physician has more access than a clinician. There is also a Login for patients but that is on an own subpage and is covered later.

After the login you are normally on the calendar view and have a main menu on the left. The style looks a bit old for the systems of today but it seems to be easy enough to find what you are looking for.

#### OpenEMR

Firefox  OpenEMR	+		<b>N N</b>		
Hide Menu					Brent King
Default  Top Bot					
10 Calendar	Add	Today	🕒 🖻 Friday, September 30, 201	1	Print Refresh Day Week Month
Messages	<ul> <li>September &gt;</li> <li>M T W T F S S</li> <li>29 30 31 01 02 03 04</li> </ul>	8:00	<sup>08:00</sup> IN¢ Terry Garcia	Debra Kilmore	Brent King
Portal Activity	05 08 07 08 09 10 11 12 13 14 15 18 17 18 19 20 21 22 23 24 28	8:30 8:45			09:00 IN o
Fees	26 27 28 29 30 01 02 Providers	9:00 9:15 9:30			
Procedures	All Users All Garcia, Teny Garcia, Teny Kilmore, Debra	9:45		10:00 IN o	10:00 c - 🌡 Reynolds, Susan
Globals	King, Brent	10:30		10:30 o - 🌡 Smith, Phil	
Facilities 🛛	Your Clinic Name Here	11:00	LUNCHO		
Users		11:15			
Addr Book		11:30			
Practice		12:00			LUNCHO
Services		12:15			
Lavouts		12:30			
Lists		12.45			
ACL		1:15			
Files		1:30			
Backup		1:45		OUTA	
Bulan		2:15		0010	
Alerte		2:30			
Aleris Refiret Deminders		2:45			
Patient Reminders		3:00	3:00 C - & Montgomery,Lindsay		
Reports		3:30			
Miscellaneous					

Figure 39. Schedule

http://www.open-emr.org/wiki/images/thumb/4/40/OpenEMR-Calendar\_4\_1.jpg/800px-OpenEMR-Calendar\_4\_1.jpg

The calendar supports finding of open appointment slots, categories for appointment types which then can have different colors and restrictions. It also supports notification via email and SMS. For the patient data OpenEMR supports patient demographics which contain primary information (such as name, date of birth, sex and identification), marital status, contact information of patient and patient's employer, primary provider, HIPAA information , language and ethnicity, insurance coverage, deceased tracking and is fully customizable.

Firefox  OpenEMR	+ K	
NEW PATIENT Hide Menu	Patient: Susan Reynolds (1) Encounter History	Home   Manual (Logout) Brent King
Default Top Bot Top Bot Calendar Messages Portal Activity Potal Activity Procedures Administration Reports Miscellaneous Popups Find Dy. Name ID SSN DOB Any Filter	Reynolds, Susan       Delete       Reset Omable Portal Credentials         History   Report   Documents   Transactions   Issues         Billing (expand)       Embody Credentials         Embody Demographics (collapse)       No active patient reminders.         Most recent vitals from: 2011-09-28 00:45:37       Blood Pressure: 120/80         Blood Pressure: 120/80       Weight: 160 00 lb (72.57 kg)         Height: 60.00 in (152.40 cm)       Temperature: 100.00 F (37.78 C)         Temp Method: Tympanic Membrane Pulse: 25 per min       Respiration: 20 per min         Respiration: 20 per min       BMI Status: Obesity 1       Oxygen Saturation: 96 %         Click here to view and graph all vitals.       Click here to view and graph all vitals.	East       Clinical Reminders (collapse)         Examination: Pap Smear (Past Due)         Assessment: Tobacco (Past Due)         Add         Appointments (collapse)         None         East         Medical Problems (collapse)         HTN         East         Allergies (collapse)         penicillin         East         Medications (collapse)         Liptor         East         D01:058-1         East         Penscription (collapse)         None

#### Figure 40. Patient overview

http://www.open-emr.org/wiki/images/thumb/b/b1/OpenEMR-Patient\_Summary\_4\_1.jpg/800px-OpenEMR-Patient\_Summary\_4\_1.jpg

Firefox	+								• • • •
NEW PATIENT Hide Menu	Patient: Theodore Smith (1) DOB: 1988-09-30 Age: 23		Encounter	History 👻				Home   Manu A	al <sub>Logout</sub> Iministrator
Intermental       Default       Image: Top Bot       Image: Top Bot <th>Current Patient save Demographics Who Contact Choices En Name: Mr. DOB: 1988-09-30 S.S.: 123-45-6789 Marital Status: Single User Defined:</th> <th>Cancel nployer Stats Misc Theodore</th> <th>Billing Smith</th> <th>Exter</th> <th>mal ID: 1 Sex: M nse/ID:</th> <th>ale 🗸</th> <th>]</th> <th></th> <th></th>	Current Patient save Demographics Who Contact Choices En Name: Mr. DOB: 1988-09-30 S.S.: 123-45-6789 Marital Status: Single User Defined:	Cancel nployer Stats Misc Theodore	Billing Smith	Exter	mal ID: 1 Sex: M nse/ID:	ale 🗸	]		
Visit History Records Visit Forms Visit Forms Fees	Insurance Primary Secondary Tertiar Primary Insurance Provider	y : Search/Add Unassigned ▼		Relationship : Subscriber :		✓ (Browse)			
Administration	Plan Name Effective Date	: : 0000-00-00	R	D.O.B. : S.S. :	0000-00-0	0	Sex:	Unassigned •	
Reports	Policy Number Group Number Subscriber Employer (SE) (if unemployed enter Student PT Student, or leave blank)			Subscriber Address : City :			State: Country:	Unassigned Add Unassigned • Add	
Popups  Find: by: Name ID SSN DOB Any Filter Online Support	SE Address SE City: SE Zip Code:	SE Unassigner State: Add SE Unassigner Country: Add	ed 🔻	Subscriber Phone : Accept Assignment :	YES •		CoPay:	)	

Figure 41. Patient's demographic

http://www.open-emr.org/wiki/images/thumb/7/7f/OpenEMR-Demographics\_4\_1.jpg/689px-OpenEMR-Demographics\_4\_1.jpg

As mentioned before it is an EMR management system and therefore can handle all the data contained in an electronic medical record such as medical issues, medications, immunizations, vitals, laboratory data, reports and notes. It has also the possibility of graphical charting, voice recognition and even creating and customizing the forms for the data input.

Firefox 🔻						- 0 <u>×</u>
OpenEMR	+				and the second second	
NEW PATIENT Patien	nt: John Kerry (6)	Encounte	r History	-	Home   N	Manual (Logout)
Hide Menu DOB:	0000-00-00 Age: 2011	Selected E	ncounter: 2011-09-30	(17)		Brent King
Default	Encount	er Summary	Administrative	Clini	cal Layout Based	
🛄 Top 🛛 Bot 🕅	Vitala					
10 Calendar	Vitais					
Messages	Name	Unit	09/30/2011 18:06:01		09/30/2011 18:05:50	
Portal Activity	Weight	lbs	140		140.00	
•	Weight	kg	63.50		63.50	
Patient/Client	Height	in	62		62.00	
J Fees	Height	cm	157.48		157.48	
-	BP Systolic	mmHg	150		120	
Procedures	BP Diastolic	mmHg	90		80	
Administration	Pulse	per min	95		80	
	Respiration	per min	16		20	
Reports	Temperature	F	98		100.00	
Mincellanaous	Temperature	С	36.67		37.78	
Miscenarcous	Temp Location		Oral	•	Oral	
	Oxygen Saturation	%	97		97	
Popups 💌	Head Circumference	in				
	Head Circumference	cm				
by: Name ID	Waist Circumference	in				
SSN DOB	Waist Circumference	cm				
	BMI	kg/m^2	25.6	-1.	25.6	
Online Support	BMI Status	Туре			Normal BL	
	Other Notes					
	Save F	orm Do	n`tSave			
					and the second	

Figure 42. Patient's vitals

http://www.open-emr.org/wiki/images/thumb/4/47/OpenEMR-Vitals\_4\_1.jpg/613px-OpenEMR-Vitals\_4\_1.jpg

There is also a form for medical billing:

Firefox 🔻	1.1					×
OpenEMR	+					+
NEW PATIENT Show Menu	Patient: Phil Smith (2) DOB: 1992-09-16 Age: 19	Encounter History Selected Encounter	- 2011-09-30 (20)		Home   Manual La Bren	t King A
Billing Manager	Choose Criteria Criteria Date of Service		Current Criteria Criteria Set To Date of Service = Today	• ×	[Update List] or [Export	user also <sub>OFX]</sub> can
	Date of Billing E Claim Type Patient Name Patient Id Insurance Company Encounter *		Dining Status – Onbined	-	[View Printable Report] [Reports] [EOBs] [View Log] [Select All]	easily use the
Generate X12	Generate CMS 1500 PDF Ge	nerate CMS 1500 TEXT	Mark as Cleared Re-Open	CMS 1500	) Margins: Left: 24 T ) (Collapse All)	op:
Phil Smith (2-20) Bill: primary: Ertny	To Enctr 2011-09-30] [To Dems] (E:	xpand)	CPT4: 99202 (033.0) 15	55.00 Debra Kilr	nore 2011-09-30	
		Figure 43. Billi	ng system			

online drug search, track patients prescriptions and medications and create new as E-Prescribe, print, fax or email. There are also options for DEA, NPI and state license numbers. And support for In-house pharmacy dispensary.

Figure 44. OpenEMR prescriptions http://www.open-emr.org/wiki/images/1/1e/OpenEMR-Prescription\_4\_1.jpg

http://www.open-emr.org/wiki/images/thumb/d/d4/OpenEMR-Billing\_4\_1.jpg/800px-OpenEMR-Billing\_4\_1.jpg

An administrator can define clinical decision rules, these are reminders for actions like cancer screening, different diabetes examines and so on.

Firefox Y			
OpenSource	eemr.com:2100/openemr/interface/main/main_screen.php/auth=login&site=di	efault	<u>~ 100</u>
			Home   Manual (Logout) Brent King
Default       Image: Calendar         Image: Calendar       Image: Calendar <t< td=""><td>Rules Configuration       Add new         Name       Adult Weight Screening and Follow-Up         Cancer Screening: Colon Cancer Screening       Cancer Screening: Mammogram         Cancer Screening: Pap Smear       Cancer Screening: Prostate Cancer Screening         Counadin Management - INR Monitoring       Diabetes: Eye Exam         Diabetes: Eye Exam       Diabetes: Hemoglobin A1C         Diabetes: Urine Microalbumin       Hypertension: Blood Pressure Measurement         Influenza Immunization for Patients &gt;= 50 Years Old         Pneumonia Vaccination Status for Older Adults         Tobacco Cessation Intervention         Tobacco Use Assessment         Weight Assessment and Counseling for Children and Adolescents</td><td>Type Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder</td><td></td></t<>	Rules Configuration       Add new         Name       Adult Weight Screening and Follow-Up         Cancer Screening: Colon Cancer Screening       Cancer Screening: Mammogram         Cancer Screening: Pap Smear       Cancer Screening: Prostate Cancer Screening         Counadin Management - INR Monitoring       Diabetes: Eye Exam         Diabetes: Eye Exam       Diabetes: Hemoglobin A1C         Diabetes: Urine Microalbumin       Hypertension: Blood Pressure Measurement         Influenza Immunization for Patients >= 50 Years Old         Pneumonia Vaccination Status for Older Adults         Tobacco Cessation Intervention         Tobacco Use Assessment         Weight Assessment and Counseling for Children and Adolescents	Type Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder Reminder	

Figure 45. Configurating Rules http://www.open-emr.org/wiki/images/4/4f/OpenEMR-CDR\_4\_1.jpg

Another feature of OpenEMR are the reports, it can create reports for many purposes, as appointments, patient lists, prescriptions and drug dispensing, referrals, immunizations, clinical measure calculations, syndrome surveillance, pending procedure orders and ordered procedure statistics, paper chart tracking, sales, collections and insurance stuff.

Firefox 👻					
OpenEMR					-
Hide Menu				Home	Manual Logout
Default	Depart Automated Measure Calculations (ANC)				Diciterating
Top Bot	Report - Automated Measure Calculations (AMC)				
1000	Begin Date:				
10 Calendar	End Date: 2011-10-06 00:59:46				
Messages	Provider: - All (Cumulative)				
2 Patient/Client	Number labe				
•	(Non-electronic) 0				
Fees					
Procedures	Title	Total Patients	Denominator	Numerator	Performance Percentage
Administration	Use CPOE for medication orders directly entered by any licensed healthcare professional who can enter orders into the medical record per state, local and professional guidelines. ( AMC:170.304(a) )	13	2	1	50%
Reports	Generate and transmit permissible prescriptions electronically. (AMC:170.304(b))	13	3	0	0%
Clients	Incorporate clinical lab-test results into certified EHR technology as structured data. (AMC:170.302(h))	13	0	0	0%
Clinic	Maintain active medication allergy list. ( AMC: 170.302(e) )	13	7	3	43%
Standard Measures	Maintain active medication list. (AMC:170.302(d))	13	7	3	43%
Quality Measures (CQM)	The EP, eligible hospital or CAH who receives a patient from another setting of care or provider of care or believes an encounter is relevant should perform medication reconciliation. (AMC:170.302(j))	13	1	1	100%
Automated Measures (AMC)	Use certified EHR technology to identify patient-specific education resources and provide those resources to the patient if appropriate. (AMC:170.302(m))	13	7	1	14%
AMC Tracking	Maintain an up-to-date problem list of current and active diagnoses. ( AMC:170.302(c) )	13	7	4	57%
Visits	Provide patients with an electronic copy of their health information (including diagnostic test results, problem list,	13	3	 0	0%
Financial	medication lists, medication allergies), upon request. (AMC:170.304(f))	15			
Procedures	Provide clinical summaries for patients for each office visit. (AMC:170.304(h))	13	10	1	10%
Insurance	Record demographics. (AMC:170.304(c))	13	7	1	14%
Blank Forms	Record smoking status for patients 13 years old or older. (AMC:170.302(g))	13	7	2	29%
Miscellaneous	Record and chart changes in vital signs. (AMC:170.302(f))	13	7	4	57%
	Send reminders to patients per patient preference for preventive/follow up care. ( AMC:170.304(d) )	13	3	0	0%
Popups 🔽	The EP, eligible hospital or CAH who transitions their patient to another setting of care or provider of care or refers their patient to another provider of care should provide summary of care record for each transition of care or referral. ( AMC:170.304())	13	1	0	0%
by: Name ID SSN DOB	Provide patients with timely electronic access to their health information (including lab results, problem list, medication lists, medication allergies) within four business days of the information being available to the EP. ( $AMC.170.304(g)$ )	13	7	3	43%
Online Support					

Figure 46. Configure the automated measure calculations http://www.open-emr.org/wiki/images/b/ba/OpenEMR-AMC\_Report\_4\_1.jpg

### 6.2 Patient Account

As mentioned above, there is also a patient portal which has a slightly different login screen, and a different-looking simplified surface.

Patient Portal Login	+	
	Patient Portal Login	0
	User Name	
	Password	
	Language Default - English (Standard) -	
	Log In	
	Powered by OpenEMR	
	r owered by OpenEwitt	

Figure 47. Patient Portal Login screen

http://www.open-emr.org/wiki/images/6/65/OpenEMR-Patient-Portal-Login\_4\_1.jpg

ittp://open	sourceemt_patient_info.php +
,	Patient Portal
	Welcome Phil Smith
	Reports (expand)
	Lab Test Results (expand)
	Problem List (expand)
	Medication List (expand)
	Medication Allergy List (expand)
	Appointments (expand)
	Log Out
4	

Figure 48. Patient Portal after logging in http://www.open-emr.org/wiki/images/e/e9/OpenEMR-Patient-Portal\_4\_1.jpg

Beside these features OpenEMR has the ability to encrypt patient documents and supports fine-grained per-user access controls. For the support there is an online documentation, a free support forum and IRC support channel and numerous of free and professional support options.

Web Links Webpage: <u>http://www.open-emr.org/</u> Demo: <u>http://demo.open-emr.org:2107/openemr/</u>

# 8. The Carrot

TheCarrot is a free online Platform that provides the user with a variety of possibilities for tracking his life, exercises, set goals, health, nutrition, overall fitness and medicine. The default format those events are depicted, is the calendar format, which with we are all somehow familiar. TheCarrot.com gives the User also the possibility to share his Health, exercise, medicine, and fitness, etc. information with care providers, community members and family. Of course this Information can also been kept private and only viewable from the user itself. This gives the opportunity to the User to have an overall view of his progress on his goals and create new goals or let the health provider set him future areas to improve in.

As TheCarrot.com is a more casual healthcare Platform it can be either used as a fitness tracker from individual Users. On the other side a more serious Use is not excluded as Doctors, Pharmacists, Nutritionists and Fitness trainers can demand a lot of details and information about the Users everyday life. This will help them to keep more track of the overall health situation the Patient is in and rearrange some goals, medicine dose, etc.

TheCarrot.com lets you track your health data, exercise progress, medicine doses in multiple and various ways. For example the user can share his information through text with his nutritionist, telling him what he ate and at what time of the day, can upload photos to the gallery, for his fitness trainer to keep track of his weight loss through the pictures and can send his doctor information about his health numbers by entering numerical data in pre made forms. TheCarrot.com gives you the possibility to track exercising time, distance and various other things as posting pictures to the private gallery through his cellphone App. The platform simplifies the task of tracking nutrition, medication data and fitness for both parties. The User who also is the patient and the Doctors, trainers, nutritionists who are the healthcare team.

TheCarrot.com is protecting privacy of its Users. Personal Data and Health records are being kept fully encrypted on the Server and will not be shared with third parties. VeriSign certified, TheCarrot.com uses a 128-bit SSL network encryption for Internet Security.

There is not a lot of Information about the Programming Language TheCarrot.com is implemented in, also which variety of Health Care Standards it fills, the minimum Requirements on the Web Server side and the internal Structure of the Platform. From the research we did, we actually found out, that it's free to use as an individual User, Healthcare Providers can build trackers for their Patients for low cost accounts. As the User can log in from the Web Browser, the Operating System used by the User is entirely irrelevant. Unfortunately at this moment, the only mobile operating System, the mobile App exists is iOS for Apple devices. Plans about porting the App into Android OS, mobile Windows OS and Blackberry OS are not known.



Figure 49. TheCarrot main page [http://thecarrot.com/]

The Login to the Platform is very easy. The User has just to open the exact link [http://thecarrot.com/] for site. On the Site there is a lot of Information. You can take a Tour through the possibilities the platform offers, get more information about the mobile App, Healthcare Providers Program, already available Programs for losing weight etc., a search bar and a Join for free Button.

			leicome mpainwm3zwa   My	Carrot   Programs   Take a Tour   Log Out
				search for food, drugs, exercise, symptoms
Home Journ	al Reports	Community	Settings	
Home Click on a tracke				
		Week Mor	th 3 Month 6 Month Year Cus	Trackers
• Snapshot	ou're o	n vour v	wav!	Food Medication
It's easy t	o record your ac	tivities. Here are a Ilar trackers.	few of the most	Customize Trackers Manage My Trackers
Enter you meals & sr	ue iacks	enter your weight	Enter your workouts	Recent Entries
۶		Ĩ		No data is available
Data to Graph Select data you'd like Measurements	to compare on the grap	1.		
no data for this date range				
No data for this date range				
▼ Nutrition				
Calories Sodium	Saturated Fat Protein	Cholesterol	Total Carbs	
			Libse	

Figure 50. Home-screen after logging in

At the Default Home-screen the User gets a lot of Tabs to work with. Home which leads the User to the Home-Screen, Journal in which the User gets the Calendar view and he can insert his Meals, Reports in which he can take his feedback from the healthcare providers he is accustomed of. The Community Tab where he can Share his Photos and Information with TheCarrot.com Community and the Settings Tab where a lot of the viewed Information Format can be altered.

Quick navigation trough the trackers is enabled as the User can click on Food, Medication or Exercise tracker, view the Recent Entries of his healthcare Team. Data can also be entered pretty fast and a Graph of the Progress is available if there is enough Information entered.

### The Carrot

	Medication Tracker Settings
	07/01/2014 - 02:45 am add photo add note edit date/time
	Here are the meds I took To track your Medications, either click on something from the list below or click on "Search" to find it in our database.
	Cancel Save and Next Save
	My Meds Common Search
	Your personalized list of favorites is empty. Setting up your favorites is easy
rec	Just click on the "Search" tab above and select the items you want to save in this journal entry. Once you click save, those items will automatically be added to your list and will appear here the next time you open this tracker!
cks	
	Add to insumal onter The Romous from anter A Romous from list

#### Figure 51. Medication tracker

Using the Medication Tracker the User gets a modal Window. Here he can keep track of the Medication he uses, the Date and add some Notes for the Doctors. My Meds Tab handles the most used Medication from the user. In the Common Tab the User can look for Medication he uses in a variety of widely and most common used Medication of the platform Users. In the Last tab a search bar is available for quick search results on Medication. Entering Medication and Doses on a weekly schedule will affect the Data Graph on the Welcome Page and also will be taken as Information from the Medical Team.

						ne mpa	ainwm	3zwa	My C	iarrot Search I	Pro	grama 1, drug	T s, exe	<mark>iake a</mark> rcise, s	Tour mptor	l Log ns	Out	
ſ	Home Journel	Reports	Communit	ity	Set	ttings		1W	- <i>3</i> \			É	A los				2	
đ	Tuesday, Jul 1, 2	014 🔹									Ca	len	dar					
12	Midnight Snack										<			July 201	4		>	
1													10	2	70 3	97 4	5	
2											6	7	8	9	10	11	12	
240											13	14 21	15 22	15 23	17	18 25	19 26	
JAM											27	28	29	30	31			
4.0		-																
5											Tr	ack	ors					
6 <sub>AM</sub>												GGR			57			
7											5	Ć				F		
8																V	<i>y</i> _	
9											E	bod	- N	fedicatio	on	Exer	cise	
10												G	uston	nize T	racke	rs		
11															Manag	le My T	rackers	
I LAM											27							
1200											Re	ecen	tE	ntrie	es			
100												No	data	a is a	vaila	ble		
2.00																		
3																		
4																		
5.		_																
6																		
7																		
0	Evening Snack																	

Figure 52. Journal View in the carrot system

The Journal Tab gives the user the previous mentioned "familiar calendar view"- layout. The User now mainly enters his Information through this Layout so he can keep track of the Medication he uses, the Food he eats and the Nutrition he takes after every Meal. The projected Layout then gives the possibility for Entries of Meals, the amount of a food type and various Information, which leads to important Data such as calories, sodium, proteins, fat, total carbs, fiber, cholesterol, etc. taken by the patient.

In the Reports Section the User gets all his important Feedback from the Health Care Team. He can get Complete Reports for him to track his eating habits, the Calories he takes and various important Information. Hyperextension enables a report with more medical related Information to be reported to the Patient, as blood pressure, heart-rate etc. various Information that is being generated through the Information the User in inputting by tracking his exercise. At last there is the Diabetes Report which can be manipulated and tracks Information about the Users health condition and the illness.

	Welcome mpainwm3zwa   My Carrot   Programs   Take a Tour   Log Out Search for food, drugs, exercise, symptoms GO
Home Journal Reports Community	Settings
Reports Choose from our reports listed below	
Thursday Juli0,2004	Weinstein     Weinstein       Windowski     Windowski       Windowski
Hypertension Report your blood pressure and heartrate with all other daily activity	

Figure 53. Reports provided by the carrot system

The Reports Section isn't limited to those three types of Reports. The more Trackers are being joined from the User and information is being inputted, more Reports will be available in this Tab. For example Flu, Food, Body, Vitals, Fitness etc. Trackers, will upload their own reports, as long the trackers are kept being fed with proper information.

In the Settings Tab we get a lot of Options to change and possibilities for modifications. Pre-made Trackers are available for to add and use. The most common Categories can be found in the left Column named "Tracker Categories". In the Middle of the Screen All Trackers can be scrolled through. The two possible Options allow the User to either Try or Add the Tracker to his Settings. Interesting fact is that a new Tracker can be suggested TheCarrot.com Team and maybe add to the "All Trackers" list. Actual available Trackers : Activity, Body Measurements, Energy Level, Exercise, Flu, Food, Job Satisfaction, Medication, Meditation, Mood, Notes, Pain, Sex, Sleep, Smoking, Steps, Symptoms, TV, Wake Ups, Blood Pressure, Heart Rate, Body Fat, Body Height, Body Temperature, Body Weight, Cholesterol, Fasting Glucose, HbA1c, Asthma, Diabetes, Hypertension, Migraine, Swine Flu, Menopause, Menstrual Cycle, Ovulation, Pregnancy, Smoking-Post Quit, Socializing, Bicycling, Running, Walking. There is a lot of diversity in the Pre-made Trackers. There are also Programs that can be joined to monitor the Users Heart Health, Diabetes, Weight management, Fitness and Smoking habit. Services to get information send directly to somebody's devices is also possible.

THERADO	or.	COM <sup>®</sup>		Welcome mpair	nwm3zwa	My Carrot	Program	s   Take a To	aur   Li	og Out
	Trac	i: yaur lite:				Search	ı for food, dru	ıgs, exercise, syn	ptoms	60
Home Journal		Reports	Community							
Trackers Prog										
Tracker Categories	All	Trackers					Caler	ndar		
All Trackers		Activity			Try	Add	Su No	July 2014		Sa Sa
General	. 10	How are you spe	ending time during t	he day				1 2	3 4	5
Body		Body Measu	irements		Try	Add	6 7 13 14	8 9 15 16	10 11 17 18	12
Lab	ш.	Keeping track of really inspire you	body measurement to stick to a diet or	s can r exercise			20 21	22 23	24 25	26
Conditions		plan. Got kids? T fashioned "penci	'his tracker replaces il on the wall" techn	the old- ique!			27 28	29 30	31 1	
Women's Health Health Programs	~	Energy Leve	el		Try	Add				
Fitness		Feeling zippy? Or your energy leve	r sluggish? Keep tra els and you can use	ck of the data			Track	ers		
Suggest a new		to compare again and exercise to s	nst other areas like see where you want	your food to make			64			-
tracker		changes.							F	
	th	Exercise Regular exercise	plays a major role i	n good	Тту	Add				
		health. It improv	ves your mood, help	s you en better.			Food	Medication	Ex	ercise
		and even puts th Our Exercise dat	he spark back in you abase has thousand	ir sex life.				Customize Tra		
		activities to choo	ose from so you can alories you're burnir	easily						Trackers
	-	Elu				_				
		If you've started	having flu sympton	ns, keep	Try	Add	Rece	nt Entries	5	
		to see a doctor o	or health professiona	il, having			N	o data is av	ailablo	
		you get the best	care.	Idke sure				, aata 15 av	unabia	
	00	Food	Disease Canadas T	L.1.	Тгу	Add				
	$\sim$	tracker is where	you enter the food	you eat						
		of items to choo	se from, each with							
		eliminate the gu	esswork.	counts to						
	A	Job Satisfac	tion		Try	Add				
		counting the ho	g while you work to urs until 5pm? Use 1	day or this						
	_	tracker to see ho	ow satisfying your jo	JU 15.						
	a	If you take medi	ications every day, t	his	Try	Add				
	-	tracker makes it Search our powe	easy to stay on sch erful Meds database	edule. to add all						
		of your medication easy entering.	ons to your Favorite	is list for						
	P	Meditation			Try	Add				
	1	Whether you on use this tracker	h at home or with a to chart the time yo	group, ou spend	-					
		in quiet contemp	plation.							
	30	Mood Trying to figure of	out what's giving vo	u the	Тту	Add				
		blues? Our mood	d tracker helps you s ght otherwise miss.	see like how						
		certain foods affe	ect your mental stat	te.						
	54	Notes	comething elec? He	e this	Тту	Add				
		tracker to record	I notes and a photo	for						
		anyoning you wa	B154							

Figure 54. Overview of all trackers which can be added

## Web Links Webpage: <u>http://thecarrot.com/</u>

# 9. Mirth Connect / DHIS2

In Addition to the already mentioned Health Care Systems there are a lot more available, many of them are open source and for the most part these systems are accessible via the internet browser and therefore on every common operating system. Even if they don't have an explicit interface for smartphones and tablets the web contents can be accessed from such devices.

There are also other kinds of applications like for example DHIS 2 which is not a tool for individual health care reports but for health management, analysis and health program monitoring. It has interfaces for desktops, laptops, tablets and smartphones.

dhis	2 DH	IIS 2 Demo	Sierra Leone			Maintena	ance Service	s Help
🚨 Tom W	akiki • Wr	ite feedba	ck • 9 unrea	d messa	ges • 3 new	interpreta	ations	
Profile I	Messages	Interpretations	Groups	Search fo	or users, charts, m	aps, reports a	nd resources	
Add Mar	nage Share	< >	Antenatal Care	Delivery	Immunization	Nutrition	Reporting Rates	Reproductive Heal
Remove View	r full size Share i	interpretation			Remove View full s	ize Share inter	pretation	
40.00 - 60 60.00 - 70 70.00 - 80 80.00 - 90 90.00 - 12 120.00 - 1	.00 (23) .00 (14) .00 (23) .00 (22) 0.00 (39) 000.00 (28)				ANC 1 Coverag	a <sup>13</sup> a <sup>13</sup> a <sup>13</sup> a <sup>13</sup> a <sup>13</sup> a <sup>13</sup> a <sup>14</sup> a <sup>14</sup> a <sup>14</sup> e ANC 3 CC Coverage	0 <sup>13</sup> 2 <sup>13</sup> 2 <sup>103</sup> 2 <sup>103</sup> yu <sup>2</sup> 2 <sup>104</sup> <sup>104</sup> <sup>1043</sup> <sup>2</sup> 0 <sup>15</sup> systemet overage Trend - ANC 3 Co	verage
Remove View	full size Share i	interpretation			Remove View full s	ize Share inter	pretation	
ANC: ANC 1	Visits Cumulativ Organisation unit	ve Numbers ANC 1st visit	ANC 1st visit_cumulative		Diarrhoea <5 y 2013-10-01	8 		
December	Sierra Leone	15975.0	15975.0		5.00 - 5.00 (46)	19	RAL	
January 2013	Sierra Leone	20026.0	36001.0		15.00 - 25.00 (3)	2)	270	
February 2013	Sierra Leone	18786.0	54787.0		25.00 - 45.00 (3) 45.00 - 120.00 (4)	3)	1995 A	SUMP.
March 2013	Sierra Leone	18576.0	73363.0		120.00 - 1000.0	) (2)		A B
April 2013	Sierra Leone	21877.0	95240.0				1-5-3-2	N A
May 2013	Sierra Leone	29461.0	124701.0				200 50	
June 2013	Sierra Leone	23813.0	148514.0			~		2 P
July 2013	Sierra Leone	22356.0	170870.0					$\sim$
August 2013	Sierra Leone	22004.0	192874.0					
September	Sierra Leone	22308.0	215182.0					

Figure 55. DHIS 2 Demo https://www.dhis2.org/sites/all/themes/dhis/images/dashboard.png

Mirth Connect is software that works as a router, filter and message transformer between different health care systems. So it can receive Data from different systems and send them to other systems and even change the format or store it in an internal database. For transportation it supports MLLP, TCP/IP, HTTP, Files, Database, S/FTP, Email, JMS, and Web Services, PDF/RTF documents and custom Java and JavaScript stuff. And beside these transport protocols it also supports several message standards. These are: HL7 v2.x, HL7 v3, XML, X12, EDI, DICOM and NCPDP.

As it is based on Java it is more or less platform independent, as long as there is a Java Runtime Environment available.

	Statue	Name .	Dout	Last Deployed	Deceived	Filtered	Queued	Sent	Errored	Conne
shboard	Status	to HTMI	0 Kev 4	2013-09-12 12:44	116	ritereu	Queueu	116	Citoreu	o Idle
annels	Started     GOV Reader		0	2013-09-12 12:44	32	0	0	32	0	Idle
ers	Paused     DICOM Receive	er	0	2013-09-12 12:44	190	0	0	190	0	• Idle
ttings	Stopped     Source	-		-	190	0	0	0	0	Idle
rts	Started     Send Email				190	0	0	190	0	o Idle
tensions	Started     E-Prescribing I	ncoming Data	0	2013-09-12 12:44	0	0	0	0	0	Idle
	Started     Started		0	2013-09-12 12:44	7,426	0	0	7,426	0	• Conne
	Started     Source			(	7,426	0	0	0	0	Conne
oard Tasks 🚷	Started     Generate I	PDF and write to file		-	7,426	0	0	7,426	0	o Idle
fresh	Started     ⊡	Generate PDF	0	2013-09-12 12:44	510	0	0	510	0	Idle
nd Message	Started     Mirth Results L	ab Message Processor	0	2013-09-12 12:44	0	0	0	0	0	o Idle
w Messages	Started     Image: Image	1esage Cleanup	0	2013-09-12 12:44	0	0	0	0	0	Idle
move All Messages	Started     Started	/ XML elements	0	2013-09-12 12:44	0	0	0	0	0	o Idle
ar Statistics	◎ Started ⊕	OAP Receiver	0	2013-09-12 12:44	0	0	0	0	0	Idle
ISE	Started XML to HL7v2	over LLP	0	2013-09-12 12:48	441	0	128	729	25	• Idle
p daalaa Chaasad	Started     Source				441	0	0	0	0	Idle
depioy Channel	Started	r			441	0	0	416	25	o Idle
	Stopped File Archive	e			441	0	128	313	0	🧧 Idle
ip out Mirth Connect It mirthcorp.com port Issue gout										
ut Mirth Connect t mirthcorp.com oort Issue out										
p ut Mirth Connect t mirthcorp.com oort Issue jout	11 Deployed Channels						Shot	w: ) Curren	t Statistics C	) Lifetime
out Mirth Connect t mirthcorp.com orf Issue out	11 Deployed Channels Server Log \ Connection Log \ Tenethere \	Channel		Connector Info			Shor	w: ③ Curren	t Statistics C	) Lifetime
out Wirth Connect t mirthcorp.com ort Issue out	11 Deployed Channels     Server Log \ Connection Log \     Tmestamp     013-09-12 (7-49-10.38)	Channel	Source: TCP Licto	Connector Info		E Tdle	Shor	w: ③ Curren	t Statistics C	) Lifetime
p U Mirth Connect tmirthcorp.com oort Issue out	11 Deployed Channels Server Log \ Connection Log \ Timestamp 2013-09-12 12:49:10.389 01:30-9:12 12:49:10.389	Channel LLP Listener	Source: TCP Liste	Connector Info rer (hLTV2 -> HLTV2		E Idle Info	Shor	W: ③ Curren 127.0.0 Senden	t Statistics C Info I. 1:6660 -> 127	) Lifetime
p ut Mirth Connect t mirthcorp.com port Issue jout	11 Deployed Channels     Server Log \ Connection Log \     Tmestamp 2013-09-12 12:49:10.389 2013-09-12 22:49:10.389	Channel UP Listener UP Listener UP Istener	Source: TCP Liste Source: TCP Liste Destination: File	Connector Info ner (HL7V2->HL7V2) ner (HL7V2->HL7V2)	) • • •	t Ide	Sho	w: ① Curren 127.0.0 Sending	t Statistics Info 1.1:6660 -> 127 response to 12	) Lifetime 7.0.0.1:50 27.0.0.1:6
p ut Mirth Connect t mirthcorp.com oort Issue jout	11 Deployed Channels Server Log \ Connection Log \ 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389	Channel LLP Listener LLP Listener LLP Listener LLP Listener	Source: TCP Liste Source: TCP Liste Destination: File Destination: File	Connector Info rer (HL7V2 -> HL7V2) rer (HL7V2 -> HL7V2) vitter - Generate PDF	) • • • • • • • • • • • • • • • • • • •	E Idle Info Idle Writing	Sho	w:  Curren	t Statistics Info 1:16660 -> 127 response to 12 file to: /foldere:	) Lifetime 7.0.0.1:50 27.0.0.1:6
p ut Mirth Connect It mirthcorp.com port Tasue gout	11 Deployed Channels     Server Log Connection Log     Timestamp 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389	Channel LUP Listener LUP Listener LUP Listener LUP Listener LUP Listener	Source: TCP Liste Source: TCP Liste Destination: File V Destination: File V Source: TCP Liste	Connector Info ner (HL7V2 -> HL7V2) Virter - Generate PDF Virter - Generate PDF	) 0 and writ 0 and writ 0	E Idle Info Idle Writing Idle	Shor	w: ① Curren 127.0.0 Sending Writing	t Statistics Info I.1:6660->127 response to 12 file to: /folders/, I.6660->127	) Lifetime 7.0.0.1:50 27.0.0.1:6 PDF/143-
p out Mirth Connect It mirthcorp.com port Issue jout	11 Deployed Channels Server Log Connection Log Timestamp 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389	Channel LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener	Source: TCP Liste Source: TCP Liste Destination: File V Destination: File V Source: TCP Liste Source: TCP Liste	Connector Info ner (HL7V2 -> HL7V2 Writer - Generate PDF Vriter - Generate PDF er (HL7V2 -> HL7V2 (HTV2 -> HL7V2)	) 0 and writ 0 and writ 0	E Idle Idle Writing Idle Idle	Shor	w: O Curren 127.0.0 Sending Writing 127.0.0	t Statistics Info Info I.1:660 -> 127 response to 12 file to: /folders/ 1.1:660 -> 127	) Lifetime 7.0.0.1:50 27.0.0.1:6 PDF/1434 7.0.0.1:50 7.0.0.1:50
p out Mirth Connect It mirthcorp.com port Issue jout	11 Deployed Channels Server Log V Connection Log V Tenestamp 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389	Channel LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener	Source: TCP Liste Source: TCP Liste Destination: File V Source: TCP Liste Source: TCP Liste Destination: File V	Connector Info ner (HL7V2 -> HL7V2 Writer - Generate PDF ner (HL7V2 -> HL7V2 rer (HL7V2 -> HL7V2 ner (HL7V2 -> HL7V2 ner (HL7V2 -> HL7V2 Viter - Generate PDF	) 0 0 0 and writ 0 1) 0 0 0 0 0 0 0 0	Ide Ide Ide Ide Ide Ide Ide	Shor Event	w: ③ Curren 127.0.0 Sending Writing 127.0.0 Sending	Info 1.1:660 -> 127 response to 12 file to: /folders/ 1.1:660 -> 127 response to 12 response to 12	) Lifetime 7.0.0.1:50 27.0.0.1:60 PDF/1434 7.0.0.1:50 27.0.0.1:60
p ut Mirth Connect It mirthcorp.com port Issue gout	11 Deployed Channels Server Log \ Connection Log \ 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375	Channel LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener LLP Listener	Source: TCP Liste Source: TCP Liste Destination: File V Source: TCP Liste Source: TCP Liste Destination: File V Destination: File V	Connector Info rer (HL7V2 -> HL7V2) rer (HL7V2 -> HL7V2) iviter - Generate PDF iviter - Generate PDF rer (HL7V2 -> HL7V2) iviter - Generate PDF iviter - Generate PDF	) • • • • • • • • • • • • • • • • • • •	E Idle Info Idle Info Idle Info Idle Viriting	Sho	w:   Curren  127.0.0  Sending  Writing  127.0.0  Sending  Writing  Viriting  Viriting  Viriting	t Statistics	) Lifetime .0.0.1:55 27.0.0.1:4 PDF/143- 27.0.0.1:5 27.0.0.1:5 PDF/143- PDF/143-
p out Mirth Connect It mirthcorp.com port Issue jout	11 Deployed Channels Server Log \ Connection Log \ Timestamp 2013-09-12 (2-49:10.389 2013-09-12 (2-49:10.389 2013-09-12 (2-49:10.389 2013-09-12 (2-49:10.389 2013-09-12 (2-49:10.389 2013-09-12 (2-49:10.375 2013-09-12 (2-49:10.375 2013-09-12 (2-49:10.375 2013-09-12 (2-49:10.375	Channel LIP Listener LIP Listener LIP Listener LIP Listener LIP Listener LIP Listener LIP Listener LIP Listener LIP Listener LIP Listener	Source: TCP Liste Source: TCP Liste Destination: File V Source: TCP Liste Source: TCP Liste Destination: File V Destination: File V Source: TCP Liste	Connector Info ner (HL7/2 -> HL7/2 Vriter - Generate PDF Vriter - Generate PDF er (HL7/2 -> HL7/2 Vriter - Generate PDF Vriter - Generate PDF Vriter - Generate PDF Vriter - Generate PDF	) 9 ) 9 and writ 9 and writ 9 ) 9 and writ 9 and writ 9 and writ 9	t Idle Info Idle Info Idle Info Idle Writing Idle	Shor	w: ① Curren 127.0.0 Sending Writing Writing 127.0.0	t Statistics info i.1:6660 -> 127 response to 12 file to: /folders/, i.1:660 -> 127 response to 12 file to: /folders/, i.1:6660 -> 127 response to 12 file to: /folders/, i.1:660 -> 127 response to 12 file to: /folders/, i.1:660 -> 127 response to 12 file to: /folders/, i.1:6660 -> 127 response to 12 file to: /folders/, i.1:660 -> 127 file to: /folders/, i.1:660 -> 127 file to: /folders/, i.1:660 -> 127 file to: /folders/, i.1:660 -> 127 file to: /folders/, i.1:60 -> 127 file to: /folders/, file to: /folders/, f	) Lifetime .0.0.1:50 PDF/143 .0.0.1:50 PDF/143 .0.0.1:50 .0.
p ut Mirth Connect It mirthcorp.com port Issue jout	11 Deployed Channels Server Log \ Connection Log \ Tenestamp 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375	Channel LIP Listener LIP Listener	Source: TCP List Source: TCP List Destination: File V Source: TCP Liste Source: TCP Liste Destination: File V Destination: File V Source: TCP Liste Source: TCP Liste	Connector Info ner (HL7V2 -> HL7V2) rer (HL7V2 -> HL7V2) Writer - Generate POF Writer - Generate POF ner (HL7V2 -> HL7V2) Writer - Generate POF rer (HL7V2 -> HL7V2) Writer - Generate POF ner (HL7V2 -> HL7V2)	) • • • • • • • • • • • • • • • • • • •	Idle Info Idle Writing Idle Writing Idle Writing Idle Info	Shor Event	w: O Curren 127.0.0 Sending Writing Writing 127.0.0 Sending	t Statistics         Info         Info         I:16660 -> 127         response to 12	) Lifetime : 7.0.0.1:50 27.0.0.1:50 PDF/1433 7.0.0.1:50 PDF/1433 PDF/1433
p out Mirth Connect It mirthcorp.com port Issue jout	11 Deployed Channels Server Log V Connection Log V Timestamp 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375	Channel LLP Listener LLP Listener	Source: TCP Liste Source: TCP Liste Destination: File V Source: TCP Liste Source: TCP Liste Destination: File V Destination: File V Source: TCP Liste Source: TCP Liste Destination: File V	Connector Info rer (hL7V2 -> HL7V2 iriter - Generate PDF ner (hL7V2 -> HL7V2 iriter - Generate PDF iriter - Generate PDF	)	E Idle Info Idle Writing Idle Idle Idle Info Idle	Sho	w: ① Curren 127.0.0 Sending 127.0.0 Sending 127.0.0 Sending 127.0.0 Sending	t Statistics     Info     1:16660 -> 127     response to 12     file to: /folders/     1:16660 -> 127     response to 12     file to: /folders/     1:16660 -> 127     response to 12     response to 12	) Lifetime ,0.0.1:50 27.0.0.1:50 PDF/1433 ,0.0.1:50 PDF/1433 ,0.0.1:50 27.0.1:50 27.0.1:50 27.0.1:50 27.0.1:50 27.0.1:50 27
p out Mirth Connect It mirthcorp.com port Issue jout	11 Deployed Channels Server Log \ Connection Log \ Timestamp 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.389 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375 2013-09-12 12:49:10.375	Channel LLP Listener LLP Listener	Source: TCP Liste Source: TCP Liste Destination: File V Destination: File V Source: TCP Liste Destination: File V Source: TCP Liste Source: TCP Liste Destination: File V Destination: File V	Connector Info rer (HL7V2 -> HL7V2) rer (HL7V2 -> HL7V2) Writer - Generate PDF Writer - Generate PDF Writer - Generate PDF Writer - Generate PDF writer - HL7V2 -> HL7V2) rer (HL7V2 -> HL7V2) Writer - Generate PDF Writer - Generate PDF	)	t Ide Info Ide Viriting Ide Info Ide Info Ide Info Ide	Shor	w: O Curren 127.0.0 Sending Writing 127.0.0 Sending Writing 127.0.0 Sending U27.0.0 Sending	t Statistics Info 1.1:6600 -> 1212 response to 12 file to: /folders, 1.1:6600 -> 1222 response to 12 file to: /folders, 1.1:660 -> 122 response to 12 file to: /folders, 1.1:600 -> 122 file to: /folders, 1.1:600	) Lifetime 7.0.0.1150 PDF/143 7.0.0.1450 27.0.0.1450 27.0.0.1450 PDF/143 7.0.0.1450 PDF/143

Figure 56. Mirth Connect Administrator System

http://www.mirthcorp.com/wp-content/gallery/mirth-connect/dashboard\_0.png

## Web Links

Webpage: <u>http://www.mirthcorp.com/</u> Webpage: <u>https://www.dhis2.org/</u>

# 10. Comparison

Name	Advantages	Disadvantages
OpenMRS	Open source	No patient accounts
	Worldwide community	Only English
	Web based	
	Platform independent	
	Best design	
	Easy to use	
Caisis	Open source	No patient accounts
	Web based	Primary developed for cancer
	Promotes standards	Only English (extensible)
	Used worldwide (reliable)	Asp.Net, needs Microsoft Products
	neat design	
	good database search options	
Nosh	Open source	
	Web based	
	Platform independent	
	Internal message and calendar design	
	Good bill support	
	Multiple accounts (doctor, patient)	
MS HealthVault	Access family data	Closed Source
	Keep track of vitals history	No control over data
		No doctor accounts
OpenEMR	Open source	
	Web based	
	Many languages	
	Many features (voice, graphs)	
	Multiple accounts	
	Good bill support	
	Automatic report generation	
The Carrot	Set health goals	Closed Source

Table 1. Comparison

OpenMRS is a strong, intuitive, web based, open source electronic health platform. It is supported by a worldwide community and entirely web based and based on Java which makes is platform independent. Another great aspect of OpenMRS is the way it feels and looks, it is very intuitive and easy to add new patients to the system. On the other hand OpenMRS is heavily based on visits, it does not support user or patient account, so updating any data requires to visit or at least contact a doctor. OpenMRS is only available in English but due to the fact of being open source also translated into other languages.

Caisis is also an open source, web based electronic health platform. It has been primary developed for cancer patients, being already used worldwide demonstrates the reliability of the system. It is easy to add new users to the system or to search for diseases or to set medications. It also offers a neat look and feel but is not as self-explaining as OpenMRS. Concerning language and patient accounts it is similar

to what we know from OpenMRS already, no patient account and only English but at least the language is extensible. Caisis is written in C# and therefor requires support for .NET and a Microsoft SQL Server, so the system itself may be free but one needs licenses for the Microsoft Products to host a Caisis system.

Nosh is another open source and platform independent system and despite feeling like using a desktop application entirely web based. One can add new accounts to the system, not only doctor account but furthermore patients or assistants which can e.g. raise an invoice. Nosh offers many features e.g. an internal message system with a calendar where patients can arrange their appointments online. In the end Nosh seems as a very solid system which is easy to use after time.

In comparison to the previous discussed system Microsoft HealthCare offers less required features for our research topic. It is not open source and does not even offer dedicated doctor accounts, instead each user can add another account as doctor. If offers a simple and neat look and has the ability to keep track of previous entered data. One can also store health and fitness info for other users and one's family. Being closed source one cannot keep track of the data or decide where and how they are stored. So we would definitely not recommend Microsoft HealthVault.

OpenEMR is written in php and therefore being a platform independent web based, open source platform. In comparison to Nosh, OpenMRS and Caisis it supports multiple languages and even more can be added to the system. As the name claims it can handle all the EMR data and supports graphical charting and even voice recognition. Administrators can create rules and reminders, e.g. several examinations needed for cancer or diabetes patients and furthermore he can create reports for all types of statistics. Patients have dedicated accounts which are quite simple to use compared to the doctor account, since they only need to access their own data. The only drawback might be the old style and the fact that it sometimes seems to be overloaded, otherwise OpenEMR is a great platform offering great features.

TheCarrot at last was the "best looking" Healthcare application we tested throughout this study. With an "intuitive" Appearance and a very helpful walkthrough in the beginning the user learns to use the platform in a playful way. The Carrot uses its own Database and we are not quite sure whether this might change when using the paid version. Also we don't know if there are more possibilities to interchange with other Platforms Information in the Health Level Seven Standard format, as it is nowhere mentioned. Patient's accounts are free to use with an easy sign up. To sign up as a doctor a license must be bought for commercial use, which we didn't do, so we are testing this Platform from the free user point of view. At the very End this Platform is in our opinion not suited for using in serious and big Organizations as it is not open source and there is no possibility to easily change the code and adapt it to the special uses of every user.

In the end we wanted to recommend a system that is open source and also features dedicated patient and doctor accounts. So the only two remaining systems are OpenEMR and Nosh. Both have nearly the same features whereas OpenEMR offers the ability for voice recognition, which is not that important since neither the doctor nor any assistant will use this feature during work time. On the other hand Nosh offers the same core features as well as an internal calendar and appointment system and a modern and neat design interface which is quite easy to use. In the end the user has to decide whether he wants Nosh or OpenEMR but we choose Nosh as best platform since it's good look and many features.

# 11. Conclusion

Going through this professional study we took a lot of things with us. In the Beginning most of our group members didn't know that Healthcare Platform existed in this way. We always thought of the Data that has being processed by various healthcare Providers as raw "chunks" of Data which consisted of this (the Patients' Health) Information.

After looking up the Definition of the Health Level Seven Norm we were astonished how much thought have been put behind all this. The healthcare branch of IT Industry had put a lot of effort and time to build those "interfaces". The simple fact that this standards were (and are being) fabricated in a clean software process, to provide safe and fast information exchange channels, was all new to us. We haven't thought that the IT business field had this much of an impact in this field. Also reading the history of the inventors of the Health Level Seven standards a lot of things left us speechless because of the very early thoughts to build something unique that would help to make everybody life easier.

Some Members of our study team didn't even know that Healthcare Platforms existed. On the other side the members knowing, or having heard about those software projects didn't know the degree of evolution they had achieved. Conducting the Study and various surveys, reading about this free Projects and even trying the most of them (for the sake of the study) learned us a lot of things. The most of us wondered how many People didn't know about Projects like this existed.

Having tested a lot of free Healthcare Platforms (most of them with available demo accounts) we came to the Conclusion that the open source Projects are to prefer compared to closed sourced Projects (which many times needed a license to unlock features and Options). We would not recommend to use any closed source system we tested during this study. The Benefits of open source projects are that there are a lot of application interfaces left open, giving the opportunity to an IT company to change and improve some passages of code. In this aspect having a finished, tested, safe and very easy to use application, which can be adjusted with a few modification to the users need, is a very powerful advantage. Also many of the close source Projects did not allow full functionalities to the user, unless he bought a license, which in our opinion is a downside of using those Projects in massive user organizations as hospitals and health insurances.

What are the benefits of Programs like this? This was the question we asked each other on the beginning of this study. Having spent a serious amount of time researching, searching, testing, comparing, evaluating and using (in some different modes) different healthcare platforms we are now asking ourselves the opposite question. How is it even possible to work without projects like this? Everything needed is there, implemented and accessible through a terminal. The internal organization and tools to support it, of a Healthcare Organization (hospital), the patients records, the upcoming schedules, Amount of medicine taken, possible consequences of the patients treatment, etc. All this Information accessible from everywhere (if somebody has the rights to access it) and interchangeable between different establishments.

After giving it a second thought, the members of this study team learned a lot of things. Standards that are imposing the Interfaces and form of data being processed and send, platforms that give somebody enormous possibilities to work with, internal organization tools and patient treatment sections. In the end we were really astonished how much the IT Branch of Industry has played an important role in the healthcare branch and had a great impact of forming it in some ways, as it is today.

# Table of Figures

All figures without any reference has been created by ourselves by visiting the corresponding webpage. Otherwise the reference is given below the figure and here in the table of figures.

Figure 1. Specific models and communication interfaces	
http://www.consorzioedith.it/public/immagineDocHisa.bmp	8
Figure 2. Login screen for the OpenMRS Platform	11
Figure 3. Welcome Page, logged in the Inpatient Ward	12
Figure 4. Patient record overview	12
Figure 5. Private patient's record note	13
Figure 6. Overview of the last patient's visits	14
Figure 7. Editing a visit note	15
Figure 8. Another overview of the past visits	16
Figure 9. Active visits listed	17
Figure 10. Registering a new patient	17
Figure 11. Caisis Login Screen	19
Figure 12. Welcome Page in Caisis	20
Figure 13. Overview of the patient's data	21
Figure 14. Registering a new patient in Caisis	22
Figure 15. Overview of all patients	23
Figure 16. Login Screen for the Nosh Platform	25
Figure 17. Welcome Screen for a provider in NOSH	26
Figure 18. Message Overview in NOSH	26
Figure 19. Calendar and schedule option for appointments	27
Figure 20. Example appointment in the calendar	28
Figure 21. Scheduling an appointment	28
Figure 22. Demographics overview and edit option	29
Figure 23. Medications handling in NOSH	29
Figure 24. Financial section in NOSH	30
Figure 25. Office Tools to handle the inventory and import and exports of files in NOSH	31
Figure 26. An appointment in the view of an assistant	32
Figure 27. Welcome Page as patient (here: Child Boy)	33
Figure 28. An appointment in the view of the patient	33
Figure 29. Listed issues	34
Figure 30. MS HealtVault after logging in	35
Figure 31. Editing a person's weight in MS HealthVault	35
Figure 32. Emergency profile in MS HealthVault	36
Figure 33. Editing Allergy information in MS HealthVault	36
Figure 34. List of several provided measurements	37
Figure 35. Health History in MS HealthVault	37
Figure 36. Look at the records history	37
Figure 37. The User's home page in MS HealthVault	38
Figure 38. Login Screen in OpenEMR	40

Figure 39. Schedule http://www.open-emr.org/wiki/images/thumb/4/40/OpenEMR-
Calendar_4_1.jpg/800px-OpenEMR-Calendar_4_1.jpg41
Figure 40. Patient overview
Figure 41. Patient's demographic
Figure 42. Patient's vitals http://www.open-emr.org/wiki/images/thumb/4/47/OpenEMR-
Vitals_4_1.jpg/613px-OpenEMR-Vitals_4_1.jpg43
Figure 43. Billing system http://www.open-emr.org/wiki/images/thumb/d/d4/OpenEMR-
Billing_4_1.jpg/800px-OpenEMR-Billing_4_1.jpg44
Figure 44. OpenEMR prescriptions http://www.open-emr.org/wiki/images/1/1e/OpenEMR-
Prescription_4_1.jpg44
Figure 45. Configurating Rules http://www.open-emr.org/wiki/images/4/4f/OpenEMR-CDR_4_1.jpg45
Figure 46. Configure the automated measure calculations http://www.open-
emr.org/wiki/images/b/ba/OpenEMR-AMC_Report_4_1.jpg46
Figure 47. Patient Portal Login screen http://www.open-emr.org/wiki/images/6/65/OpenEMR-Patient-
Portal-Login_4_1.jpg47
Figure 48. Patient Portal after logging in http://www.open-emr.org/wiki/images/e/e9/OpenEMR-
Patient-Portal_4_1.jpg47
Figure 49. TheCarrot main page [http://thecarrot.com/]50
Figure 50. Home-screen after logging in51
Figure 51. Medication tracker52
Figure 52. Journal View in the carrot system53
Figure 53. Reports provided by the carrot system54
Figure 54. Overview of all trackers which can be added55
Figure 55. DHIS 2 Demo https://www.dhis2.org/sites/all/themes/dhis/images/dashboard.png
Figure 56. Mirth Connect Administrator System http://www.mirthcorp.com/wp-content/gallery/mirth-
connect/dashboard_0.png57

## Declaration

I hereby declare that the work presented in this thesis is entirely my own.

I did not use any other sources and references that the listed ones. I have marked all direct or indirect statements from other sources contained therein as quotations.

Neither this work nor significant parts of it were part of another examination procedure. I have not published this work in whole or in part before.

The electronic copy is consistent with all submitted copies.

Signature:

Stuttgart, 15.09.2014