Open Sourse Software Development on Medical Domain

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1. Introduction

The expansion of information technology (IT) in daily tasks and computerization has had multiple impact in our lives. This is particularly illustrated in the benefits of electronic healthcare records (EHR), from both the perspective of the healthcare provider and the patient. IT has been shown to improve efficiency and safety for healthcare delivery(Halamka et al., 2005).

With the advent of the Internet, many patients are eager to obtain information about their health instantly. Health related words are popular terms on the Internet search key words on the web (Eysenbach & Kohler, 2003). Quite a number of Net-savvy patients look up their possible conditions before meeting the physician.

For governments, efficiency of the healthcare policies is a big concern, because total expenditure for health care has been rising year by year (OECD, 2011). It is reasonable idea that information technology will improve efficiency in medicine, as in the other domains. President Obama of the US declared to invest to propagate EHR to improve health care quality and efficiency with massive Budget (Clinton, H. R. et al., 2006).

However, even with all the positive implications of EHR, many healthcare organizations have yet to implement them. This is not due to skepticism about their benefits but mainly due to financial reasons. Inadequate capital for purchase and maintenance cost are the significant barriers to many organizations (AK et al., 2009). Issues such as difficulty committing to a particular vendor and concerns about compatibility of the chosen vendor's system with existing and future systems have to be considered before implementing EHR.

This global problem also affects Japan. It is estimated that to implement an EHR system in a Japanese hospital will cost approximately USD 10,000 per hospital bed. If this was scaled up to full HER implementation for all medical organizations in Japan (of which there are about 150,000), the Japan Medical Association (JMA) estimated this to cost roughly USD 180 billion over a 10 year period. Given that the size of the Japanese medical market is about USD 300 billion per year, this technology is not readily affordable in Japan without a significant reduction of costs. One approach to reducing the high cost of clinical information system is to integrate various existing clinical systems. A major barrier to this solution is the lack of established standardized data communication protocol and consequently communication among different systems is problematic. Another potential solution to reducing the high costs of implementing IT systems in health care is the use of Open Source Software (OSS).

OSS movement around medicine has gained momentum in this decade. A technical report has been described about this medical OSS movement (Morrison et al., 2010). International Medical Informatics Assotiation (IMIA) launched OSS SIG and has a website to share information as well providing the OSS available for download. In this chapter, we discuss about the movement and its background, introduce major of the and illustrate the future of the software technology in the medical domain. More information is available at IMIA OSS SIG site (www.medfloss.org/).

2. Open Source Software (OSS)

Open Source Software can be defined as computer software for which the human readable source code is made available under a copyright license (or arrangement such as the public domain) that meets the Open Source Definition (Open Source Initiative, 1997–2005)[1]. This includes free distribution of the software, the inclusion of the source code in the program, and permitted modifications and derived works which can be distributed under the same terms as the license of the original software. In addition, the license itself should not be specific to a product, must not restrict other software and must be technology neutral. In essence this permits users to use, change, and improve upon the software as well as allowing it to be redistributed in modified or unmodified form. This in turn has considerable commercial and technical benefits.

The availability of OSS source codes allows engineers to avoid reinventing the wheel and to concentrate instead on developmental efficiency. Proactive use of OSS promotes a low cost and short delivery time of software and this has, for example, been beneficial in the development of software for the Internet.

A particularly attractive appeal of OSS is that an organization (user) gains confidence for future availability and full ownership of its data and customizability of its software by avoiding 'vendor lock-in'. Organizations can freely adapt OSS to their personal needs performing any necessary customization themselves or by employing a third party.. This is in marked contrast to proprietary software where the organization is dependent on the vendor's willingness to perform any customization, usually has little control over how quickly they perform the customization and will inevitably pay a substantial fee for it. The organization would also not have any control over a vendor's decision to change data format or even structure.

2.1 Open source and standards

It is no doubt that the Internet has become widespread rapidly and accompanied with great innovations. It was suggested that one of the reasons that the Internet succeeded was that the synergy between open source software and open standard had promoted the movement (Kenwood, 2001). This synergy has also driven innovation in the medical domain(Reynolds & Wyatt, 2011).

With respect to the implementation of standards, Health Level 7 or HL7-compliant OSS is abundant throughout the world. Mirth is well designed platform to handle HL7 standards

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[1] OSS is also called as FLOSS (Free/Libre/Open Source software). FLOSS is more correct term for use, but in this chapter OSS is used on behalf of FLOSS

(Table 1)(Brauer, 2008). Mirth connect supports multiple standards, HL7 v2.x, HL7 V3, XML, X12, EDI, DICOM, NCDP, and delimited text.

Project name	Mirth
Description	Interoperability solution for health care
Platform	Java, ESB
License	MPL license Ver 1.1
Project site	http://www.mirthcorp.com/

Table 1. Technical overview of Mirth

The openEHR Project has standardized these programs according to their unique modeling method and has released them as the ISO/EN 13606 standard (The openEHR Foundation, n.d.). The openEHR project gathered more than 1500 developers and clinicians from 58 countries as of October 2011. The development platform utilized ranges from Eiffel, Java, and Ruby. OSS and open standard products have improved interoperability of the Internet, and can similarly improve the interoperability of medical systems.

3. OSS in medicine

A wide range of OSS solutions are already in use in healthcare. Many of these are technical tools and business applications, e.g. Linux, Apache, LibreOffice.org, and so on, but a large number of healthcare domain specific OSS also exists. As of October 2011, there are 572 healthcare related OSS available for download from SourceForge. Most of them are developed by small groups, but some major projects are maintained by industry and commercial support is available. International collaboration has been also grown, motivated in some communities which share similar problems in healthcare.

In this section, major medical OSS projects are shown with description. If you are interested in the topics, please join their community.

3.1 EHR

Hospitals have adopted information systems to manage clinical practice. Commonly, a hospital needs integrated EHR to administer clinical information from subsystems for departments, such as laboratory data, pharmacy, radiology section etc. As of other enterprise domain, proprietary vendor systems are also dominant in medical domain, but OSS is getting a larger share in this field today. In this section, major EHR projects are shown for example below.

3.1.1 OpenEMR

OpenEMR is one of the most popular OSS in medical domain, and was developed by a not-for-profit company which was founded in 2005 by a medical doctor and owner of a small primary care facility in North Carolina. It supports medical practice management, electronic medical records, prescription writing and medical billing (Table 2)(Fig 1) (OpenEMR Project, n.d.). OpenEMR is freely customisable, becase it based on widely used platform built on PHP to construct web application and MySQL database.

It supports multiple languages, and are used in the United States, Puerto Rico, Australia, Sweden, Holland, Israel, India, Malaysia, Nepal, and Kenya. OpenEHR was also certified

Project name	OpenEMR
Description	Electronic medical record and medical practice management
Platform	PHP, MySQL
License	GPL
Project site	http://www.oemr.org/

Table 2. Technical overview of OpenEMR

by ONC (Office of the National Coordinator of Health Information Technology) as complete ambulatory   EHR   (Office of the National Coordinator for Health Information Technology, n.d.).

Fig. 1. Screenshot of OpenEMR

3.1.2 OpenVistA

VistA is an integrated comprehensive clinical information system supporting clinical, administrative, financial, and infrastructure functions (Table 3)(Veterans Health Administration, n.d.).   Its components include a graphical user interface, computerized order entry system, bar-coded medication administration, electronic prescribing and clinical guidelines. It was developed by the Departments of Veteran Affairs in the United States to serve the more than 4 million military veterans cared for in its 150 hospitals and 700 clinics. It is mature enough and very versatile to be configured to fit any type of health care organization, from clinics and medical practices to nursing homes and large hospitals.

OpenVistA is an open source software project based on VistA technology. OpenVistA has been adopted for use by several other health institutions in America as well as hospitals in other countries, e.g. Egypt, Germany, and Mexico. However, Technology of Vista is not based on modern computer language or platform. It is controversial that health care system should use novel technology or stable technology, but you have to consider that engineers who skilled in MUMPS are available or not for your project.

Project name	OpenVistA
Description	Electronic health record for all clinical field, based on veteran's hospital information system
Platform	MUMPS, Delphy/Kylix
License	Public domain, GPL
Project site	http://www.oemr.org/

Table 3. Technical overview of WorldVistA

3.1.3 OpenMRS

OpenMRS is a community-developed, open source, electronic medical record system platform. It has been developed by community, led by a collaborative effort of the Regenstrief Institute (Indiana University) and Partners in Health (Boston Philanthropic Organization).

OpenMRS is focused on building and managing health systems in the developing world, where AIDS, tuberculosis, and malaria afflict the lives of millions (Table4) (Fig. 2)(OpenMRS Project, n.d.).

Prevention and surveillance of infectious disease benefits from an OpenMRS system. OpenMRS has been supported by the Google Summer of Code from 2007. OpenMRS uses MySQL databases, Java, Spring framework, Microsoft InfoPath for its forms development.

Project name	OpenMRS
Description	Infection control system for developing countries
Platform	Java, Spring framework, Microsoft InfoPath
License	OpenMRS Public License 1.1
Project site	http://openmrs.org/

Table 4. Technical overview of OpenMRS

3.1.4 PatientOS

PatientOS project has aimed to produce the highest quality, free enterprise-wide healthcare information system, and been designed from the onset to be a hospital information system (Table 5)(Fig. 3). The software architecture, design patterns and framework has been built for the complexities and challenges of an enterprise-wide information system. PatientOS supports not only human hospitals, but also veterinary care hospitals (Fig. 4).

Local business support for PatientOS is available in US, Canada and India.

3.1.5 GNUmed

The GNUmed project provides EMR in multiple languages to assist and improve longitudinal care, specifically in ambulatory settings (i.e. multi-professional practices and clinics) (Table

Fig. 2. Screenshot of OpenMRS

Project name	PatientOS
Description	Infection control system for developing countries
Platform	Java, JBoss, Myrth
License	GPLv3
Project site	http://www.patientos.org/

Table 5. Technical overview of PatientOS

6). It is made available at no charge and is capable of running on GNU/Linux, Windows and Mac OS X. GNUmed cleanly separates the medical aspects (record keeping) from the administrative aspects (billing, storage) of a medical practice. Thereby it allows GNUmed to be internationalized to different jurisdictions.

Project name	GNUmed
Description	EMR, specifically in ambulatory settings
Programming language	Python
License	GPL
Project site	http://www.gnumed.org/

Table 6. Technical overview of GNUmed

3.1.6 FreeMED

FreeMED is an OSS electronic medical record and practice management system which has been developed since 1999 (Table 7)(Surhone et al., 2010). It was first developed by Jeffrey Buchbinder in the United States for general practitioners. It evolved to have an international
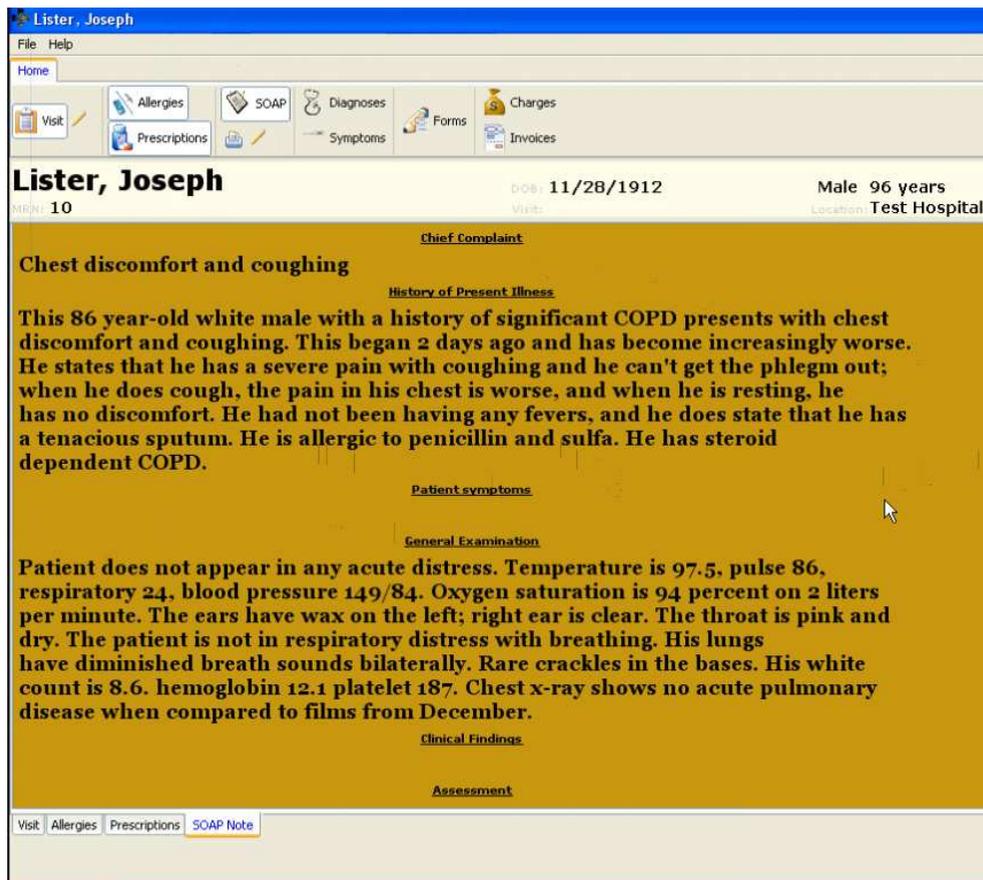
Fig. 3. Prescription form of PatientOS

development group and has been translated into a variety of languages. The platform was so called LAMP (Linux, Apache, MySQL and PHP), but now being refactored to J2EE for scalability. FreeMED is currently hosted by FreeMED Software Foundation, which is a non-profit corporation. Primary goal of FreeMED is the betterment of the open source software community and the world in general through promoting development and adoption of FreeMED and other open source medical software projects. Commercial support is available For FreeMED.

Project name	FreeMED
Description	EMR for general practitioner clinics
Programming language	PHP, MySQL, (Re-factoring to J2EE)
License	GPL
Project site	http://freemedsoftware.org/

Table 7. Technical overview of FreeMED

Fig. 4. Pet registration form of PatientOS

3.2 Digital imagings

Clinical imaging is necessary for modern physicians to make diagnosis. Digital imaging have improved portability of clinical image and enhanced quality of pictures that are calculated with the aid of computers. A picture archiving and communication (PACS) system has been developed to manage such digital images from various modality, such as X-ray, CT, MRI, PET and so on. Typical systems had been developed by vendors of digital image devices equipped as an accessory of devices. Today, PACS become independent software on devices to manage digital images, because standardization is widely accepted to many devices as DICOM (Digital Imaging and Communication in Medicine). Open source PACS has been developed and has now become widespread.

3.2.1 OsiriX

OsiriX is a popular OSS for medical imagery viewer (Rosset et al., 2004)(Table 8, Fig. 5). OsiriX was developed on Mac OS X by Dr Antoine Rosset and Dr Osman Ratib, in the department of radiology and medical computing of Geneva (Switzerland). OsiriX can also display DICOM standard format images from most of common modalities (ultrasound, CT, MRI, PET, etc). OsiriX is works mainly on Mac OS X, but also provide clients for iOS, such as iPad or iPhone and Windows clients can viewed image via a web server extension.

If you use large amount of digital images, additional 64 bit package might be necessary, but it is proprietary, too. However, for personal use, OsiriX basic package is very useful for physicians and even for radiologists.

3.2.2 dcm4che

dcm4che is a powerful and robust OSS DICOM and medical standard server (Warnock et al., 2007)(Table 9). It is a collection of open source applications and utilities for the healthcare enterprise. These applications have been developed in Java.

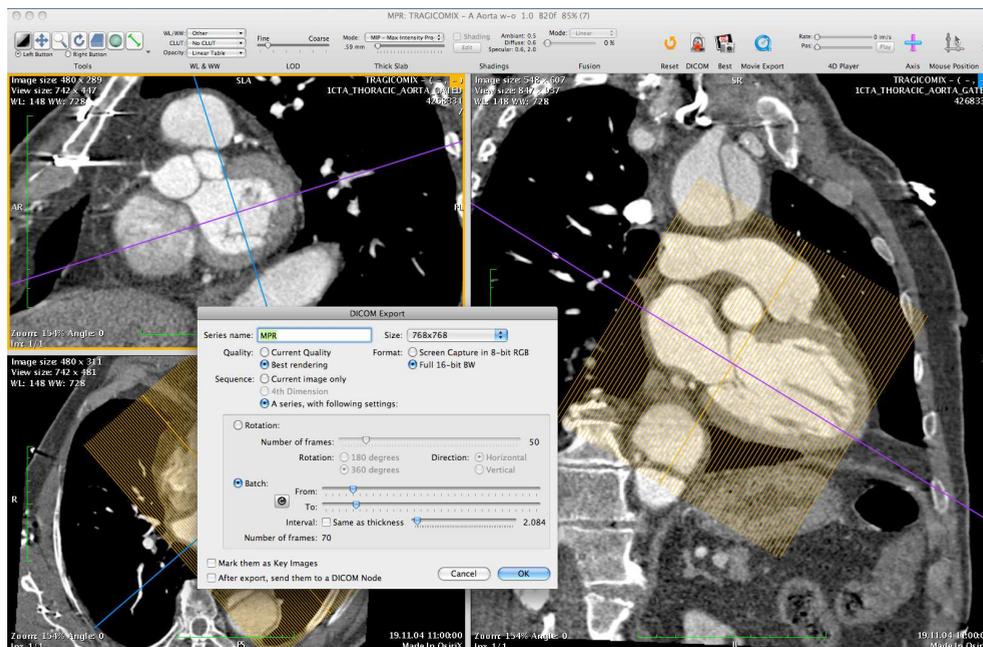| Project name	OsiriX
Description	Clinical image viewer for Mac OS X
Platform	Objective C, Cocoa framework
License	LGPL
Project site	http://www.osirix-viewer.com/

Table 8. Technical overview of OsiriX

Fig. 5. Screenshot of OsiriX

Also contained within the dcm4che project is d (the extra 'e' stands for 'enterprise'). dcm4chee is an Image Manager/Image Archive (according to IHE; Integrating the Healthcare Enterprise). The application contains DICOM, HL7 services and interfaces that are required to provide storage, retrieval, and workflow to a healthcare environment. dcm4chee is pre-packaged and deployed within the JBoss application server. By taking advantage of many JBoss features (JMS, EJB, Servlet Engine, etc.) and assuming the role of several IHE factors for interoperability, the application provides many robust and scalable services to provide standardized messages related to clinical imaging works including HL7 and IHE-XDS.

Project name	Dcm4che
Description	DICOM server, archive and manager
Platform	Java, JBoss
License	MPL/GPL/LGPL triple license
Project site	http://www.dcm4che.org/

Table 9. Technical overview of Dcm4che

3.3 Research in biomedicine

Biomedical science also benefits from OSS. Bioinformatics has launched a number of OSS to build tools for their research (Dennis, 2004). Bioinformatics, which is a new frontier of biology, was a key technology to achieve Human Genome Project (Stein, 1996). At first, bioinformatics library was developed by Perl, but now many computer languages are available for bioinformatics and most of them are OSS. Many OSS tools are utilized for biomedical research, even if they are not targeted to biomedicine. R is a open source statistical environment for universal use, but is also used in biomedical statistics widely(R Development Core Team, 2005).Thus, OSS for biomedical research is an active domain. Some major projects are shown below for example.

3.3.1 OpenClinica

Medical research projects are supported by OpenClinica, a web-based platform for managing clinical studies(Table 10)(Akaza Research, n.d.). It is an industry-led software for capturing and managing clinical trial data. It allows users to build their own studies, design electronic Case Report Forms (eCRFs), and conduct a full range of clinical data capture and management functions. It also supports enterprise edition as hosting or already deployed form.

OpenClinica is designed to be used in diverse types of clinical studies. It supports Good Clinical Practice (GCP), regulatory guidelines such as 21 CFR Part 11, and is built on a modern architecture using leading standards.

Project name	OpenClinica community edition
Description	Clinical research support platform
Platform	Java, Spring framework/Hibernate
License	LGPL
Project site	https://community.openclinica.com/

Table 10. Technical overview of OpenClinica

3.3.2 ImageJ

ImageJ is a digital image processing tool for biological laboratories (Table 11)(NIH, n.d.). It was inspired from NIH Image on Macintosh. It can display, edit, analyze images of multiple formats, such as TIFF, GIF, JPEG, BMP, DICOM, FITS and raw. It can process pixel-value statistics to analyze magnification of the data. Many plug-ins are available for specialized processing.

Project name	ImageJ
Description	Laboratory image processing
Platform	Java
License	Public domain
Project site	http://rsbweb.nih.gov/ij/

Table 11. Technical overview of ImageJ

3.3.3 NetEpi

NetEpi, which is short for Inter **Net** -enabled **Epi** demiology, is a suite of OSS tools for epidemiology and public health practice which makes full use of the Internet (Table 12). NetEpi Collection is a data collection and management tool for use in communicable disease outbreaks and other epidemiological investigations and studies. It is written in Python and uses only open source software components and infrastructure, including the PostgreSQL database.

Project name	NetEpi
Description	Tools for epidemiology and public health
Platform	Python
License	MPL 1.1
Project site	http://code.google.com/p/netepi/

Table 12. Technical overview of NetEpi

4. Medical OSS in Japan

Japanese medical practice is generally subsidized by public health insurance programs. To receive reimbursement, doctors need to submit details of medications prescribed and treatments administered to their patients. To meet the government's accounting rules a health insurance computing system called *'Receipt Computer'* was developed during the 1970's and released in the 1980's. This software was expensive to deploy, costing as much as US$ 50,000 even in very small clinics or hospitals. Nevertheless, it was installed in 90% of clinics and hospitals in Japan as it could meet the complex bureaucratic accounting procedures. The high cost of the software inevitably placed a financial strain on clinics. In addition all the data entered in the receipt computer was locked into the vendor's proprietary software and could not be utilized for any other purpose or with any other systems without paying the vendor additional fees for integrating it.

To address the high costs of commercial software and to avoid any dependency on a specific vendor or technology, the JMA decided to provide its members with an OSS based information and communication infrastructure. In 2000, it presented an OSS project known as ORCA (On-line Receipt Computer Advanced) with two major goals (Japan Medical Association, 2001). The first was to provide a networked system with software for submitting claims for government reimbursement (named as 'JMA standard receipt computer') and related applications at low or no cost to JMA members. The second was to use the knowledge and experience from the project to inform healthcare policymakers about the potential of OSS for other aspects of medical management in Japan, particularly for electronic healthcare records.

All the components of the JMA standard receipt computer are OSS (Table 13). The platform is Debian GNU/Linux and Ubuntu Linux, using PostgreSQL for database system. JMA provides standardized terminology databases about disease, drug, operation, and contraindication of drug combination. MONTSUQI is a middle ware designed for this system to monitor transaction of modules to database system. This system has its own rich client implemented with customized gtk 1.2, because Japanese needs input method for Japanese characters, i.e. kanji, hiragana, and katakana. Web environment cannot switch input method on demand in the forms field . MONPE is a printing environment that can design complex receipt form with many ruling lines. At first, OpenCOBOL was developed for ORCA project,

Product Name	Description
PostgreSQL	Relational database management system.
MONTSUQI	Transaction monitor
MONPE	Report printing environment
OpenCOBOL	COBOL compiler
Debian GNU/Linux, Ubuntu Linux	OS environment

Table 13. Components of JMA standard receipt software

because the developer of the ORCA needed qualified COBOL compiler. OpenCOBOL is now widely used for migration of legacy system to Linux system(The OpenCOBOL Project, n.d.). The ORCA project also released the other related products as OSS(Japan Medical Association, 2000). Ikensho, one of the products of the ORCA project, is a reporting system for care insurance system for the government. Today, nearly 20,000 medical providers in Japan are using Ikensho, and the number of participants is increasing. According to the ORCA website in Oct 2011, 11,395 clinics and hospitals (about 11 percent of share) have adopted JMA standard receipt computer The software is free and can be installed by individuals themselves or by JMA-authorized vendors in which case, a fee is payable.

The Medical Open Software Council was established 2004to investigate potential applications of OSS in the medical field in Japan,. OpenDolphin was developed as a client part of the regional health care system and is now independently utilized in many clinics in Japan(MINAGAWA, n.d.). OpenDolphin has a standardized connectability to JMA standard receipt computer via CLAIM protocol(MedXML Consortium, n.d.). This is one of the reference implementation of CLAIM protocol. NOA is an EMR system that was formerly developed by Dr Ohashi for his clinic use and released as OSS for public use(OHASHI, n.d.). Dr Ohashi, is a gynecologist and has developed his EMR system for more than twenty years.

More and more medical OSS has been developed in Japan. One of the key areas where OSS may play a role is standardization of medical data transaction protocols, as described previously. In Japan, there are few vendors of medical information systems, limiting competition and driving up the cost of information systems. The limited number of vendors also creates other problems such as 'data lock-in' state, in which the hospital cannot use information entered within its system in intuitive ways as it is limited by the functionality and features provided by the vendor. In addition, 'vendor lock-in'may also occur, in which an organization cannot change vendors because their present vendor will not provide them with the necessary information about their system to allow data migration to take place. These problems do not occur with OSS and users consequently avoid any 'lock-in state'.

As OSS resources become more commonly used in the medical field, barriers to new vendors should be reduced, and more vendors will be attracted to the medical field. The increased competition should break the oligopoly of vendors in Japan and lead to greater diversity and lower cost of medical IT systems. At present, each organization may operate slightly differently from other organizations, and clinical information systems usually have to be customized for individual organizations, which increases the initial cost. With greater uses of OSS systems the diversity of available clinical information systems will increase and therefore be easier adapted to the needs of new organization without the need for extensive customization.

4.1 Medical OSS in Asia/Africa

Developing countries in Asia/Africa share many problems in health care. Infectious disease control is one of the most severe problems, which is the target for OpenMRS. Many African countries and WHO have supported OpenMRS development as an effective political action.

Another problem is education for young engineers to develop software for medicine. The United Nations University International Institute for Global Health (UNU-IIGH) in Kuala Lumpur, Malaysia has a short training course to teach OSS development and operation[2]. UP Manila, the national telehealth centre of Philippines, has also lead medical OSS movement in Asia.

Community Health Information Tracking System (CHITS) is a web-based electronic medical record developed by the University of the Philippines College of Medicine for government health facilities in the country (Fig. 6). It runs on a Linux system using Apache, MySQL, and PHP. Developed by Dr Herman Tolentino in 2003, CHITS is now expanding to more sites in the Philippines. It contains all the important programs utilised by the Philippine Department of Health and the Philippine Health Insurance Corporation.

Fig. 6. Screenshot of CHITS

The International Open Source Network ASEAN+3 (www.iosn.net) was established by UNDP as a center of excellence for free and open source software in the region. It conducts conferences and trainings on FLOSS for health through the UP Manila National Telehealth Center (www.telehealth.ph). Some of the FLOSS topics had been on geographic information systems for disasters and OpenMRS.

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[2] http://iigh.unu.edu/?q=node/85

5. Discussion

OSS offers great promise for realizing the vision of ubiquitous, low-cost, and quality EHR systems to support healthcare. The absence of license fees and the removal of dependency on a single vendor remove some of the most significant barriers to the implementation of EHRs.In addition, the absence of common data standards which makes it difficult to integrate systems or change from one EHR system to another, may also be addressed by OSS.

Although OSS clearly has many attractions, potential drawbacks must also be considered. As OSS development depends mainly on volunteers and usually provides its products *'as is'*, some people are skeptical about its security and availability. However, comparisons of OSS with proprietary software have been favorable (Raymond, 1997). For example, the analysis of source codes for the Linux kernel has been reported to have fewer bugs (Coverity Inc., 2004), and be more reliable than proprietary software (Miller et al., 1995; 1990). OSS has also been shown to respond more quickly than proprietary software in releasing patches to identified vulnerabilities. Clinical information systems must have a high level of security to maintain patient privacy. OSS can theoretically be made more secure than proprietary software because it can receive input from many developers (Coverity Inc., 2004; Miller et al., 1995; 1990; Raymond, 1997).

As described earlier, the potential of OSS has been recognized in the medical field, and many healthcare related OSS projects have achieved success (Japan Medical Association, 2000; OpenEMR Project, n.d.; OpenMRS Project, n.d.; Veterans Health Administration, n.d.). However, many problems remain to be solved. The development of OSS requires many developers with numerous skills and ideas in order to produce a good product, and as a consequence OSS projects recruit developers worldwide. Unfortunately, worldwide projects are rare in medicine, because each country has its own unique medical system and thus software cannot readily be shared without specific adaptations and a literal translation of the language. When language is not a barrier, the practice is exactly the same throughout the world, e.g. viewing radiology images, OSS can be readily used with minimal or no adaptation (NIH, n.d.; Rosset et al., 2004; Warnock et al., 2007). Furthermore, despite differences in medical systems, the work flow at hospitals does not differ markedly among countries, making it possible to produce a unified worldwide medical application. To accomplish this, a worldwide medical project should separate common and local components (e.g. accounting, insurance claims, etc.) and standardize their interoperability.

Even OSS is superior in terms of the quality of software, medical organization still needs vendor's support to maintain information systems. To qualify the support of vendors, JMA label OSS vendors which has enough skill to support ORCA systems. The authenticated vendors are listed in the JMA web site. At first, unskilled vendors confused medical organizations, but the labeling program has improved service of vendors and eliminated wrong vendors from the market of medical information systems. While many medical organizations have reaped the benefits of OSS with the labeling of skillful vendors, some medical providers cannot be supported in some area, mainly in the Japan countryside . The offices of OSS vendors are mainly located in urban areas, because they can get access to many other jobs as well. OSS support vendors are increasing in number, but their skillsare quite varied and their distribution area uneven. For every medical organization to have OSS benefit, more and more OSS vendors should be cultivated. This means, medical OSS market should grow enough to sustain OSS vendors. The ORCA project has been shown to be one of the most

successful Medical OSS projects; suggesting that this labeling program might be appropriate to be developed in other countries as well.

OSS is sometimes used for purposes other than those intended by the developers. Although OSS has not been developed specifically for clinical use, some OSS has been adapted for the clinical situation. Similarly, OSS that has been developed for medical applications may also be used in other fields as OpenCOBOL (The OpenCOBOL Project, n.d.) or CGI.pm (Stein, 1996). OSS should be enriched not only for clinical use but also for use by the entire OSS community, as human intellectual property.

6. Conclusion

Even in medical field, OSS has the potential to improve both clinical operations and the interoperability of the medical systems. A number of promising OSS projects in the medical field may benefit both medicine and human intellectual property.

7. Acknowledgments

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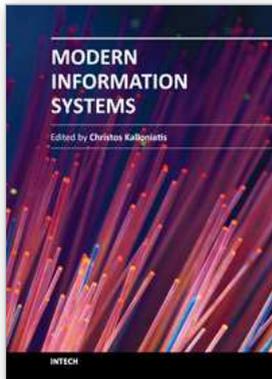
Modern Information Systems

Edited by Dr. Christos Kalloniatis

The development of modern information systems is a demanding task. New technologies and tools are designed, implemented and presented in the market on a daily bases. User needs change dramatically fast and the IT industry copes to reach the level of efficiency and adaptability for its systems in order to be competitive and up-to-date. Thus, the realization of modern information systems with great characteristics and functionalities implemented for specific areas of interest is a fact of our modern and demanding digital society and this is the main scope of this book. Therefore, this book aims to present a number of innovative and recently developed information systems. It is titled "Modern Information Systems" and includes 8 chapters. This book may assist researchers on studying the innovative functions of modern systems in various areas like health, telematics, knowledge management, etc. It can also assist young students in capturing the new research tendencies of the information systems' development.

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