

Electronic Health Object: Transforming Health Care Systems From Static to Interactive and Extensible

Mohammad Nabil Almunawar, PhD¹, Muhammad Anshari, PhD¹,
Mustafa Z. Younis, PhD², and Adnan Kisa, PhD³

Abstract

Electronic health records (EHRs) store health-related patient information in an electronic format, improving the quality of health care management and increasing efficiency of health care processes. However, in existing information systems, health-related records are generated, managed, and controlled by health care organizations. Patients are perceived as recipients of care and normally cannot directly interact with the system that stores their health-related records; their participation in enriching this information is not possible. Many businesses now allow customers to participate in generating information for their systems, strengthening customer relationships. This trend is supported by Web 2.0, which enables interactivity through various means, including social networks. Health care systems should be able to take advantage of this development. This article proposes a novel framework in addressing the emerging need for interactivity while preserving and extending existing electronic medical data. The framework has 3 dimensions of patient health record: personal, social, and medical dimensions. The framework is designed to empower patients, changing their roles from static recipient of health care services to dynamic and active partners in health care processes.

Keywords

Clinic 2.0, electronic health record (EHR), electronic medical record (EMR), electronic health object (EHO)

Introduction

Health care organization is a service industry that is always challenged with efficiencies, equities, and provision of qualities in delivering services. In principle, the quality of health care services should be improved by electronic processing and the availability of medical data.¹ Electronic health (e-health) was introduced to improve information access and flow, efficiency, effectiveness, and quality of health care processes and service delivery. E-health initiatives are progressively taking place worldwide to support efficient health care management and business processes, and to fulfill increasing consumer demand for online services.

E-health cannot be separated from electronic health records (EHRs) or electronic medical records (EMRs), as essentially both are core parts of an e-health system. The primary goal of an EHR is to make medical data available beyond physical borders. However, many essential EHRs are still recorded on paper or within isolated databases. Even modern health care centers with advanced health information systems limit access to EHRs for authorized users.²

EHRs have evolved to become center-stage in the national health informatics strategies of most European countries and

internationally.^{3,4} Health care professionals increasingly need to access details from health records to manage the safe and effective delivery of complex and knowledge-intensive health care, and to share this information within and between organizations.⁵ More patients are now demanding access to their EHR to an extent that permits them to actively participate in their health care management. This is becoming more urgent as the focus of health care delivery shifts from specialist centers to community settings and to the patient's personal environment.⁴ Health care has transformed from a static system, where patients are perceived as recipients of care to an interactive and dynamic health care system that recognizes patients as partners in the health care processes.

¹Universiti Brunei Darussalam, Brunei

²Jackson State University, MS, USA

³Zirve University, Gaziantep, Turkey

Corresponding Author:

Mustafa Z. Younis, School of Public Health, Jackson State University, 1400 Lynch Street, Jackson, MS 39213, USA.

Email: younis99@gmail.com



Recent developments in interactivity on the Web (Web 2.0) mean that consumers are motivated to have better control of the information flowing within their social networks. Consumers are able to interactively converse among themselves to confirm and even criticize services, products, or the performance of businesses that they have experienced. Web 2.0 has driven changes in consumer behavior in terms of interaction and empowerment, enabling consumers (patients) in health care environments to have conversations and interactions among themselves. These patient-to-patient interactions are a form of electronic empowerment (e-empowerment) whereby they can share, discuss, and even generate records (content) of their health-related activities and services provided by their health care providers. Web 2.0 has the potential to support better partnerships between patients and their health care providers for mutual benefits.

The present article aims to present a promising research direction that may shape the future of health care systems. We review the roles of EMRs and EHRs and propose a new representation of health or medical data by reorganizing and extending EMRs with Web 2.0 features. This new representation, electronic health object (EHO), is designed to improve the extensibility of health-related data and accommodate patient interactivity in health care systems using the Web 2.0 concept. EHO uses an object-oriented approach to flexibly and robustly extend the existing stationary EHR to interactive health records and information. EHO comprises 3 main objects: *personal*, which captures activities of individual daily life that may directly or indirectly affect the individual's overall health status; *social*, which captures the patient's social networking activities; and *medical*, which is the emulation of conventional EMR that may consist of records of checkups, outpatient treatment (O/P), and inpatient treatment (I/P). The next section presents the background of the study, followed by discussion of EHO. We then discuss the application of EHO in e-health and its contribution to patient empowerment. Finally, we present our EHO prototype (Clinic 2.0).

Related Work

Like many companies, health care providers have several lines of business. These include medical examination, treatment, prescription, marketing and health promotion, and pharmacies. Each of these lines of business is characterized by a specific combination of objects. Some objects are specific to 1 line of business; others are common to several lines of business. The user derives the meaning of an object from the business domain of that object and from the context in which the object is used.⁶

EMRs and EHRs are the foundation of e-health systems.⁷ These concepts and their extension to accommodate online collaboration through Web 2.0 tools and strategies are discussed below. We explore the adoption of Web 2.0 technologies in health care business lines and service delivery, and

focus on the intersection of EMRs in e-health and potential use of Web 2.0 to facilitate social networking, participation, and collaboration. The term Medicine 2.0 is also discussed to provide a parallel for Web 2.0 in a health care organization environment.

EHR and EMR

Currently, the meaning of EHR is variable. As EHRs have many functions and include many kinds of data, it is necessary to explicitly determine what EHR means.⁸ According to the International Organization for Standardization (ISO),⁹ EHR means a repository of patient data in digital form, stored and exchanged securely, and accessible by multiple authorized users. An EHR contains retrospective, concurrent, and prospective information, and its primary purpose is to support continuing, efficient, and quality integrated health care.

EMRs are defined as electronic medical data and reports about patients' conditions, images, physiological signals, checkups, medical treatment videos, and medical forms.^{10,11} EMRs allow patient health records to be stored, updated, and exchanged between various medical facilities and health care organizations nationwide.¹² The functionality provided by these systems include simple patient records, elaborate patient management, electronic medication ordering, and billing systems.¹³ They can improve the quality of health care delivery; increase efficiency, transparency, and clarity in medical records; decrease medical errors; provide easy access to consolidated patient records; reduce physician mental workload; decrease duplication of medical tests; and reduce staff time in locating and extracting information from patient files.¹⁴

EMRs contain the records of a patient's health-related information generated and owned by a particular health care provider, whereas EHRs contain the records of a patient's long-term and aggregated health-related information generated by encounters in any care delivery setting, and stemming from the interoperability of multiple providers. EHRs may also contain patient demographics, progress notes, problems, medications, medical history, immunizations, laboratory data, and radiology reports.¹⁵

Neither an EMR nor EHR allows patients to update and add content, even though this content may be useful to help improve treatment.¹⁶ Patients are therefore not sure what authority they have in interacting with their health data or clinical records. The Web 2.0 tools, discussed below, have made sharing information and content easy and fast. We argue that patients should be dynamically included to enrich information related to their daily activities, habits, or other information useful for their health-related records. With this in mind, EMRs and EHRs may be extended to allow dynamic Web 2.0 concepts to be used in e-health services, meaning dynamic and rich content from diverse sources can be used to create innovative ways to view health information. We

used an object-oriented approach to define our novel EHO concept.

Medicine 2.0

The impact of Web 2.0 technologies on health continues to grow, and the term Medicine 2.0 has entered popular categorization. According to Hughes et al,¹⁷ the terms Medicine 2.0 and Health 2.0 were similar and could be categorized by (1) the participants involved (eg, doctors, patients), (2) the impact on traditional and collaborative practices in medicine, (3) the ability to provide personalized health care, (4) the ability to promote ongoing medical education, and (5) associated method- and tool-related issues, such as potential inaccuracy in end user-generated content.¹⁷ In comparing definitions of Medicine 2.0 with e-health, key distinctions are made by the collaborative nature of Medicine 2.0 and its emphasis on personalized health care. However, there are common elements such as health or medical education.

Medicine 2.0 refers to the use of a specific set of Web tools (eg, blogs, podcasts, tags, search, wikis) by actors in health care including doctors, patients, and scientists, using principles of open source and user-generated content, and the power of networks to personalize health care, and collaborate and promote health education.¹⁷

Supporting this are 5 themes that we define as follows:

1. *Participants*: different stakeholders in Medicine 2.0.
2. *Method/tools*: the manner in which Medicine 2.0 information is created and owned (eg, accuracy of user-generated information, open source or ownership, and the use of specific tools such as wikis).
3. *Collaboration and practice*: Medicine 2.0 as a tool to promote participants' interests as readers (staying informed), or to communicate and collaborate collectively for their own practice.
4. *Medical education*: Medicine 2.0's educational potential for the general public, training health professionals, or ongoing education for specialists (examining and collaboration on a particular patient case).
5. *Personalized health*: Medicine 2.0 as a mechanism to provide customized health care, such as connecting patients with rare conditions and improving health care value for an individual.

Some doctors resist for their patients' to use Medicine 2.0 to generate information as they worry about information inaccuracy and potential risks associated with inaccuracy, and privacy and ownership issues. There are some interesting debates on this issue.¹⁷

The first debate relates to agreement on the existence of Web 2.0.¹⁸ This debate has flowed into Medicine 2.0, with discussion about terms such as Health 2.0 possibly not existing.¹⁹ However, some researchers have argued that Medicine 2.0

and Health 2.0 may be terms that have evolved for different audiences such as academic, business, and health consumers.^{17,20}

Second, doctors' resistance to their patients' use of Medicine 2.0 may be due to unwanted patient behavior such as not consulting a physician, consulting a physician too late, or coming to wrong conclusions about their disease management even if the information available to them online is accurate.

Third, methods used to generate Medicine 2.0 information risk inaccuracy. However, in exploring specific information about an Internet-based cancer support group, most information was accurate and false or misleading statements were rapidly corrected.²¹ The impact of information accuracy and credibility in relation to e-health should not be worried too much as patients tend to use both intermediate (experts, authorities) and distributed (Medicine 2.0) information to make their health decisions, thereby reducing risk from inaccurate user-generated online information.²⁰

Finally, debate relates to the consequences of the methods used to generate Medicine 2.0 information. In addition to information accuracy, the nature of health information means that privacy, ethical, legal, and ownership issues are critical.¹⁷ This also applies to doctors who may use social networking sites for medical education and debate.²² Overall, good models are needed to realize the advantages promised by Web 2.0 and develop new sources of health information sharing.

Methods

The present study was conducted in 5 stages: a literature review, developing a reference model, conducting a survey, developing the prototype, and testing. The literature analysis informed development of the reference model and guided the next stage. In the third stage, a survey was conducted based on the features of the reference model. The survey aimed to confirm user requirements and their perspective on the features of the proposed model. The results of the survey were used to develop our prototype (Clinic 2.0) in an iterative approach. Finally, we tested Clinic 2.0 in a health care center of Indonesia. Details of the survey have been published elsewhere.²³

Electronic Health Object

EHRs and EMRs were developed on the basis of patients as solely recipients of care with content generated by health care providers. Patients or their families have no authorization to access this information, no means to dynamically contribute to generating content, and no media to share information or seek opinions from other patients/health care providers.²⁴ As neither an EMR nor EHR allows patients to update and add new content, the records are static medical information entities with all data generated or controlled by health care providers.

We argue that patients should not be considered as solely recipients of care, as they are partners in the whole health care process because of the information and knowledge they have. Patients can help themselves or at least partly self-care during long-term health care processes.²⁵ A new concept that incorporates this view and a new strategy to make it happen are necessary. Viewing patients as partners in care implies that patients are empowered in a dynamic health care process. It means health care organizations should incorporate patients in generating the content of health records, which are considered to belong to patients or perceived as beneficial if they empower patients or their families. For example, patients' personal data and daily habits can be modules that they are authorized to access and self-manage.

EHO extends EHR by incorporating patients as partners of care, empowering them to generate content and have control of their own health records. Although complex, especially in defining who and what to access, providing e-empowerment offers the advantage of patients (consumers) becoming actively involved in their health care processes. EHO was developed using an object-oriented approach as this allowed us to dynamically expand an EHR-based system with the concept of usability and extensibility.

To achieve our goal, we needed to redefine the objects and their roles within electronic information flow. The term *object* refers to the object-oriented paradigm in information systems or computer science. Objects are reusable components as they are independent encapsulations of state and operations. A reusable component is a piece of software that is independent of any application. A broad overview of the relationship between components and objects is that each component is an object that is not bound to a particular program, computer language, or implementation.²⁶

In object-oriented terminology, an object class is a template of objects comprising attributes and operations. The object class is a container for objects and used to create objects; a child class inherits attributes and operations from a parent class. Object classes can be organized in a hierarchy that shows the relationship between general and more specific object classes. Objects communicate by sending messages that will invoke the associated methods in other objects. Figure 1 illustrates an object-oriented approach to determine objects in the class *medical* that focus on object *diseases*.

The EHO concept views e-health activities as groups of objects with embedded attributes and behaviors. The EHO proposes a comprehensive view of the role of the patient within an e-health system, suggesting that a patient as a partner in the health care process has 3 distinct roles: an individual health actor, a social health agent, and as a partner in the medical care process. These roles are represented in the system as object classes *personal*, *social*, and *medical*. Object class *personal* refers to the module (object) personal daily life activity (PDLA). Object class *social* is represented by the module social life activities (SLA). Finally, object

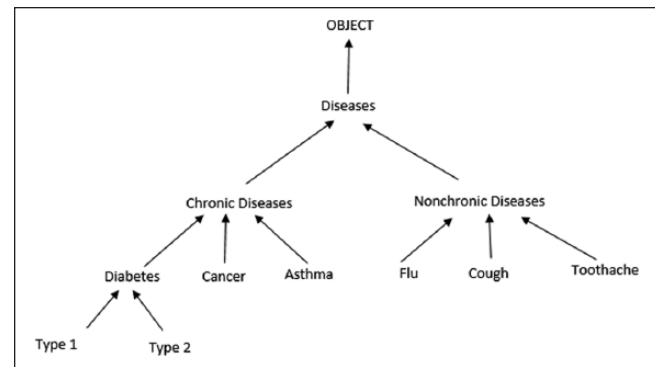


Figure 1. Object-oriented approach.

class *medical* refers to medical activities (MA) such as checkups, O/P treatment, and I/P treatment.

In EHO, object class *medical* is comparable with the concept in EMR. With this in mind, EHO proposes to extend an EMR by accommodating the dynamic *social* and *personal* roles. To understand the differences between EHR and EHO, Table 1 summarizes EHO concepts as distinct from EHRs'. EHO places e-health information exchange at the center. It assumes that extensive e-health services authorize patients to partially participate in the process of health care activities (PDLA, SLA, MA). Patient involvement empowers them to achieve health prevention, health literacy, and be able to take better action for personal health decision making.

Figure 2 sets out the information flow in an EHO scenario where the source of information includes patient data, knowledge resource, and directory information. Patient data are categorized as personal health data and personal medical data. EHO proposes that personal health data and medical data are synchronized to obtain a comprehensive view of patient data. In conventional systems, medical data refer to EMR and are mostly generated by health care staff. Distinguished personal health data differ from personal medical data.²⁷ Personal health data are the individual's personal habits that may affect the overall health status of that individual.²⁸ For example, eating and sleeping habits may affect blood pressure and the process updating this information may be empowering for the individual.²⁹ Sources of information from personal health data or medical data should accommodate multiple health care providers to ensure personal health data are comprehensible.

The knowledge resource manages the accumulation, dissemination, and distribution of comprehensive health knowledge that is accessible to users, including patients, patients' families, doctors, researchers, and health care management. The knowledge resource aims to help users stay informed about the latest developments and to enable them interact, discuss, and contribute to the content of the knowledge resource.³⁰ What makes EHO different is that patients are authorized to access, update, post queries, or verify information stored in the knowledge resource. To ensure information

Table 1. EHR Versus EHO.

	EHR	EHO
Definition	Tools that allow patient health records to be stored, updated, and exchanged between various health facilities and health care organizations nationwide ¹²	Extensive e-health services in health care organizations that empower patients to participate in the process of health activities and decision making as individual health actors, accommodating social characteristics for collaborative sharing, and at the same time being a partner in medical care
Domain coverage	Medical and/or personal	Object classes <i>personal</i> , <i>social</i> , and <i>medical</i>
Patient's role	Recipient of medical care	Individual health actor, social health agents for sharing, and a partner in medical care process
Functionality/purpose	Improve the quality of health care management; increase efficiency, transparency, and clarity in medical records; decrease medical errors; easy access to consolidated patient records; reduce physicians mental workload; decrease duplicated medical tests; and reduce staff time in locating and extracting information from patient files ¹⁴	Improve patients' personal health literacy and prevention, customer satisfaction, patient empowerment, and collaboration and sharing between patients and health care providers. Achieve better personal health decision making
Type of interaction	One-way provider-patient interaction, but mostly accessible by the provider only	For providers to improve effectiveness and efficiency of health care management For communities to direct health promotion and community involvement
Generating data	Static	Multiway interaction (patient-patient, patient-provider); collaboration and conversation around topics of common group interest
Users	Medical staff, authorized third parties	Dynamic, supports user contribution, especially <i>personal</i> and <i>social</i>
Access control	Limited to medical staff and management	Patients, medical staff, authorized third parties, and community
Business approach	Organization centric	Complex authorization to accommodate various users and accessibility
Technical platform	Classic Web or desktop application	Patient centric (home-based)
Application	Closed application	Web as a platform Modular and supporting mashups ^a

Note. EHR = electronic health record; EHO = electronic health object.

^aMashups combine existing services into new, useful applications joining information.

quality and reliability, an individual may contribute to the knowledge resource after verification of general clinical evidence, while knowledge originating from social networks can be placed in different cluster to distinguish the level of information quality and integrity. The directory consigns the expertise and services available to the health care organization to a database.

EHO and Patient Empowerment

The introduction of EHO within e-health systems is expected to have a positive effect on health prevention and patient empowerment. E-health initiatives can provide effective self-service that empowers patients and allows organizations to reduce costs by handling an increasing number of consumer transactions more efficiently. There is good evidence that coaching patients using e-health empowerment strategies leads to broadened, less negative definitions of illness as well as improved patient self-management. However, without commitment from health care organizations, the benefits of empowerment are unlikely to emerge.³¹

Web 2.0 drives changes in customer behavior in terms of interaction and empowerment, enabling customers (patients) to engage in conversations and interact with other patients. This between-patient interaction is another form of empowerment, as they can share and discuss health-related issues including services provided by health care organizations.³² The ability to view medical records proposed by EHO is another form of empowerment that can promote self-awareness and may improve health literacy.³³

Enabling patient access to their medical records may also simplify requests for second opinions from other health or medical practitioners, although the privacy and confidentiality of medical staff involved must be upheld. Social networking media are another form of patient empowerment offered by EHO. Sharing knowledge and information in social networks provides patients or their families with knowledge and information about their health concerns. For example, patients with diabetes may like to share and discuss experiences with other patients with diabetes, for moral support or to exchange information or experiences. Empowerment through EHO may also contribute to decision making; more information

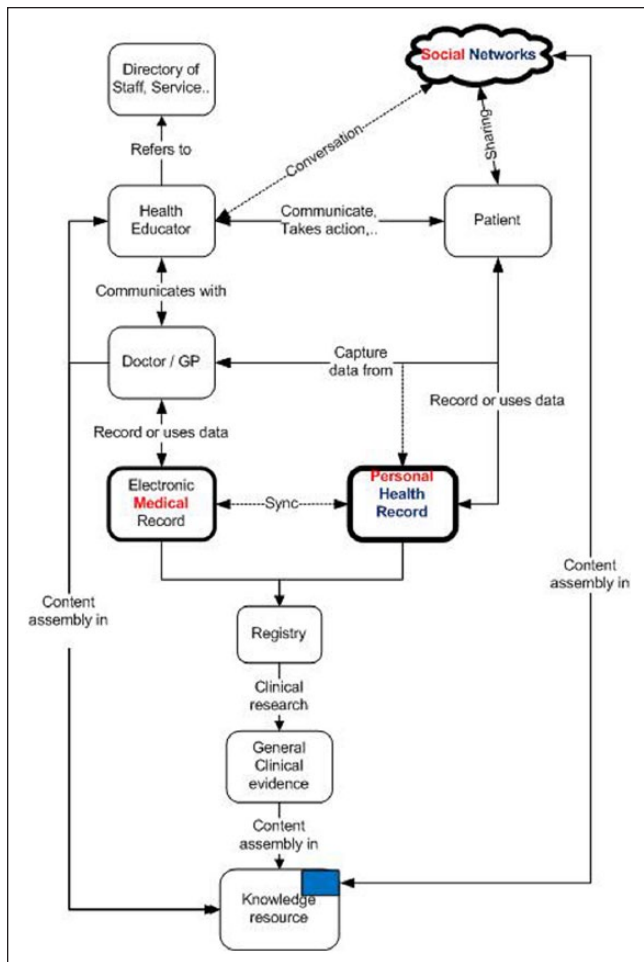


Figure 2. Information flow in EHO.

Note. EHO = electronic health object.
GP = general practitioner.

available to patients means more accurate and reasonable decisions can be achieved.

Figure 3 presents the EHO business architecture, encompassing object classes *personal* (PDLA module/object personal), *social* (SLA module/object social), and *medical* (MA module/object medical). In a traditional e-health system, object class *medical* is similar to EMRs.

Object *personal* consists of object *identity/profile* (ID), object *personal habits* (HB), object *exercise* (EX), object *emotional and spiritual* (SE), object *personal health plan* (HP), object *personal account* (AC), and more objects depending on need and urgency. Object class *social* consists of all objects related to social networking and media, including object *conversation* (CS), object *knowledge management* (KM), and object *resolution* (RS). Finally, object *medical* consists of activities such as objects *e-appointment* (EA), *examination* (XM), *treatment* (TM), and *e-prescription* (EP). Each object also contains sub-sub modules. For example, object XM may be composed of chronic disease (cc) and nonchronic disease (nc). In turn, chronic disease comprises

diabetes (da), cancer (ca), obesity (ob), and others. The object-oriented approach allows an object to inherit attributes and methods/operations from the parent object(s).

How does the model support e-empowerment? The object-oriented approach helps to determine the process of e-empowerment. Some activities (represented as objects) have embedded information and actions that can be delegated to patients and/or their families. For example, object classes *personal* and *social* can be fully empowered to patients/families. However, the object class *medical* cannot be fully empowered to patients/families because of the mechanism by which information and actions are shared, such as authorization and access control.

Figure 3 shows an e-health service as an integrated health care activity that governs personal health care processes in relation to personal, medical, and social activities. The model suggests that e-empowerment can be assigned to any object class or at a subclass level. The circle with a solid yellow line indicates that empowerment has been assigned to that object, whereas no circle means empowerment has not been assigned. A circle with a yellow dashed line indicates partial e-empowerment. For example, a health care provider only gives patients authorization to read his or her medical records.

EHO offers a holistic view and mechanism for health care providers to give e-empowerment to their customers based on a modular approach. However, e-empowerment within the object class *medical* needs goodwill from health care providers and may need to conform to the law that protects medical records. For instance, Australian government has introduced a revolutionary e-health system through Personally Controlled Electronic Health Records (PCEHR). PCEHR supports patients to view their medical records; however, the ability to update medical records is strictly disabled using object-oriented approach in Clinic 2.0. Object *medical* is divided into 2 objects: *chronical diseases* and *nonchronical diseases*. For nonchronical diseases, Clinic 2.0 empowers patients to update their medical status into the systems. For instance, in the case patients get fever and influenza, they can input their medical condition and their own treatment to the system. By looking at those medical records generated by patients, physicians can have a broader perspective of patients' condition.

Implementing EHO With Clinic 2.0

Clinic 2.0 is a prototype of e-health system based on EHO using the Web 2.0 platform. It implements the paradigm of an interactive health care system where the patient is perceived as partner in care. Although Clinic 2.0 does not implement complete modules as proposed in the EHO business architecture (Figure 3), it offers multiway patient interaction. Three possible relationships involved in an e-health system are patient alone (patient interactions with the system), patient-to-patient interactions, and patient-to-health care provider interactions.

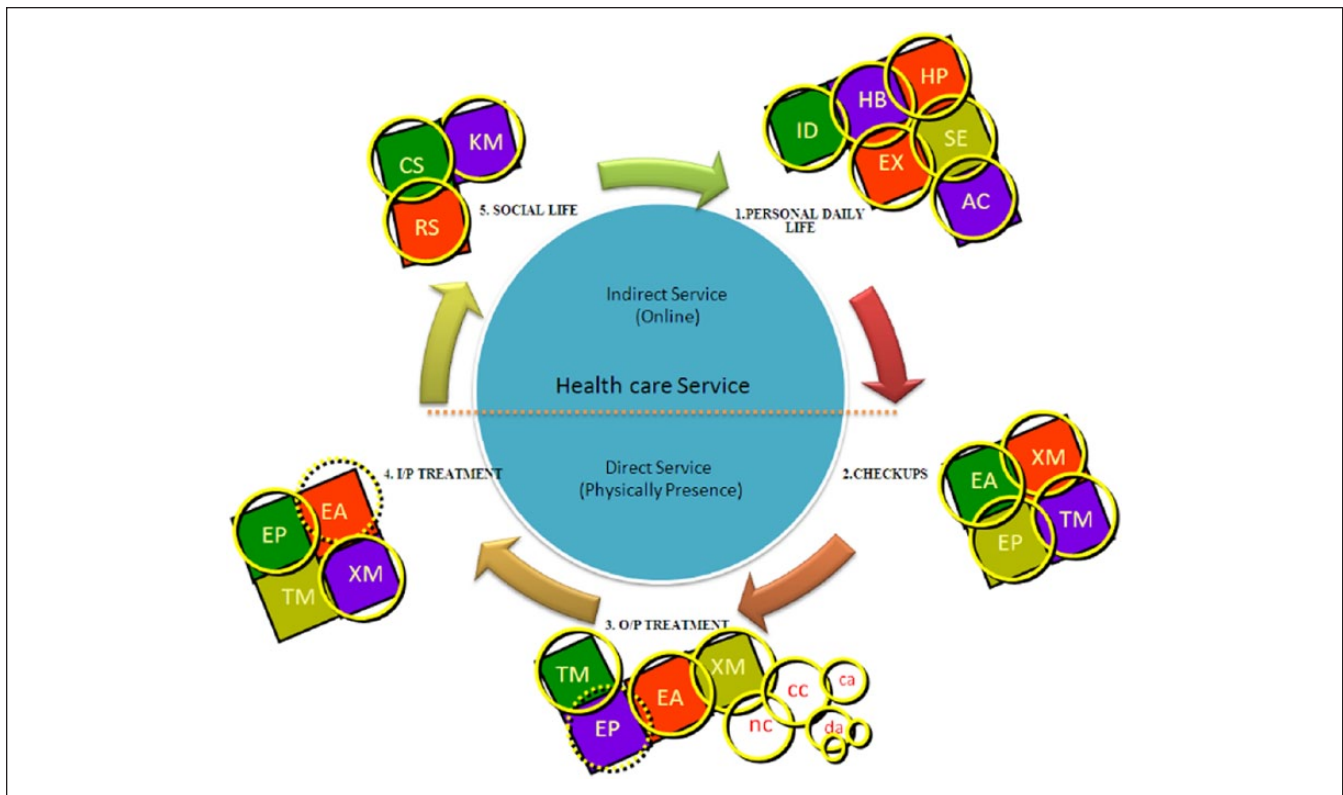


Figure 3. EHO business architecture.

Note. EHO = electronic health object; ID = identity; HB = habits; HP = health plan; EX = exercise; SE = emotional and spiritual; AC = account; EA = e-appointment; XM = examination; TM = treatment; O/P = outpatient treatment; I/P = inpatient treatment; EP = e-prescription; nc = nonchronic disease; cc = chronic disease; ca = cancer; da = diabetes; RS = resolution; CS = conversation; KM = knowledge management.

Personal objects refer to a patient's ability to have interactive sessions with Clinic 2.0 systems. Interactivity means the patient is able to participate in generating content and data into Clinic 2.0 as well as retrieving data or content when it is needed. This feature is not possible in the traditional e-health system, as the static approach views the patient as a recipient of care with no means of interaction with the system.

A significant element of patient interactivity is achieved by enabling them to view their medical information electronically. Object class *personal* contains personal health information that the patient is fully authorized to view, update, and delete at any time. An individual can dynamically interact with the system to acquire their own health information and personal habits.³⁴

Medical objects enable Clinic 2.0 to support the interaction between health care providers and their patients. The interactions concern with the medical activities (eg, store, update, exchange, record, retrieve, medication, ordering, prescription) from patient checkups, I/P or O/P treatment, where the presence of medical staff is compulsory to ensure the quality and reliability of medical records. The scope and dimension of object class *medical* are limited to clinical or medical treatment and activities.

Figure 4 shows a screenshot of Clinic 2.0 consultation history. Consultation history exists within the object class *medical*. It is composed of specific fields: date, diagnosis treatment,

hospital (place), medical staff, and action. This module is authorized for health care providers or medical staff to enter all required information. Patients can view their consultation history but cannot change anything recorded by the health care provider. In the future direction, patients will be able to update the consultation with the guidance from an online health educator. However, there must be a mechanism and authentication process for information entered by patients. For example, a patient seeks a second opinion from another health care provider; the result of that consultation can be added to the existing record.

Finally, social objects in Clinic 2.0 offer multiway interactions that empower patients through patient-patient conversations. It is an informal means of interaction between patients to share experiences and discuss issues related to health care services or medical concerns. It encourages patients to express concerns and feelings through a channel provided by the organization so that it can be part of the health care process. A health care professional or team (online health educator) should monitor the conversation process and provide support or assistance as needed during the conversation. The presence of online health education within a conversation is important to ensure the quality of information. Online health education can deepen relationships between health care providers and patients.

CLINIC 2.0

add

HomeMy HealthMedical RecordLogout

General

Consultation History

Follow Up

Schedule

Prescriptions

Consultation History

Data for Zuhairah Zuhairah

View User's Data

Submit

Add Date

Date	Diagnosis	Treatment	Hospital	Medical Staff	Action
2012-03-05	Kulit berakutang lepuh akibat 2 hari T ₁ 170/90 mmHg BSA 215 mg/dl	Dipanganiti Metformin Clozapril	Aisyah	Khadijah Ais	
2012-03-09	T ₁ 150/90 mmHg GDA 127 mg/dl Batuk (-)	HCT Metformin Omeprazole	Aisyah	Khadijah Ais	
2012-04-02	Batuk terus menerus, pusing(-), GDA 143 mg/dl T ₁ 130/80 mm	Anahar Gabas Vit. B1	Aisyah	Khadijah Ais	
2012-04-10	Perut terasa mules (-) 2 hr, jari-jari tangan dan kaki terasa lemas	Glibenclamide Metformin Alopurinol	Aisyah	Khadijah Ais	
2012-05-01	Mula(-), mual(-), muntah (-) T ₁ 150/90 mmHg GDA 203 mg/dl BSA	Hyemida Captopril Glibenclamide Metformin	Aisyah	Khadijah Ais	
2012-05-15	Batuk pilek, pengorokan getah, nyeri telan T ₁ 150/90 mmHg GDA	HCT GG Dexa Vit. C Eritromisin Glibenclamide Metformin	Aisyah	Khadijah Ais	

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Figure 4. Clinic 2.0 consultation history.

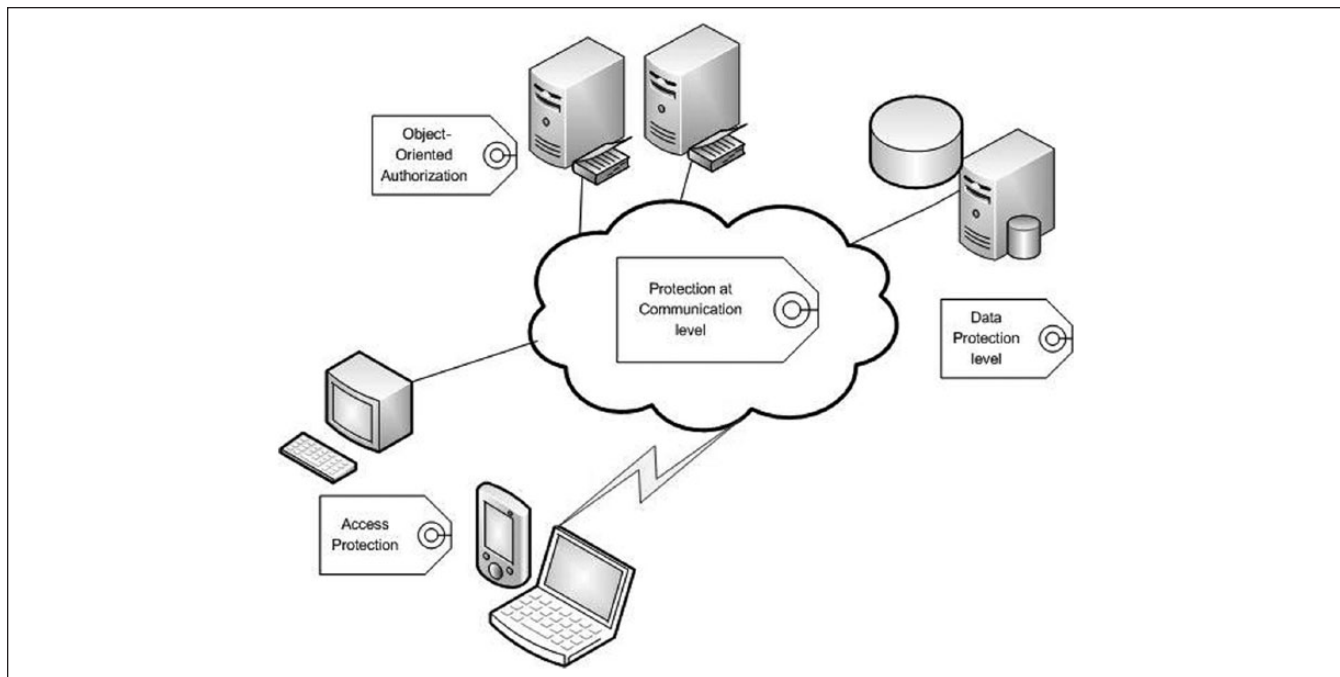


Figure 5. Security mechanism in Clinic 2.0.

Privacy and Security

Privacy and security are the main concern in an e-health implementation. In fact, many patients hesitate to adhere to using the service if there is no guarantee of privacy and security. However, the need for interconnectivity and accessibility is strong, and the law in accessing personal health information protects individuals. It is challenging from the technical, organizations, and legal perspectives. However, the advantages offered by e-empowerment are promising such as involving patients in the health care process, increasing efficiency in managerial tasks, and improving health awareness or health literacy of users.

There is no doubt that all health care professionals must uphold confidentiality of their patients' data. Consequently, it is in need of the system to meet requirements such as maximum security, sufficient privileges for users to fulfill their respective tasks, and easy user maintenance. Implementing a client/server environment over the Internet provides great flexibility. However, in an e-health environment, highly sensitive information is at a greater risk of being lost, manipulated, and spoofed.

Figure 5 shows a security concept and an authorization design to meet the demands for data protection in Clinic 2.0. There are 4 layers of security mechanisms to ensure all

aspects of activities and information is secure: first, access protection given to users to access the service from the Internet; second, an object-oriented authorization design; third, ensuring that protection is provided at a network communication level; and, finally, log activity monitoring, routine, and nonroutine analysis of network assessment must be carried out to understand access patterns toward the systems.

Conclusions

Health care organization is heavily dependent on Information and Communication Technology (ICT). Many e-health initiatives to improve health care efficiency and effectiveness have been widely proposed. EMR and EHR are 2 well-known health record systems, which have many similarities and share the objective of improving efficiency and effectiveness of health care business processes through ICT. However, EHR has wider data coverage than EMR, as it contains a patient's long-term and aggregated health-related information generated by 1 or more encounters in any care delivery setting stemming from the interoperability of multiple providers, rather than health-related data generated by a particular health care provider.

EHO was developed using an object-oriented approach that allows usability and extensibility, meaning that EHO is more flexible than EMR or EHR. Traditional EMR and EHR were developed on the basis of patients being sole recipients of care. EHO incorporates patients as partners in care, empowering them to generate content and to have better control or access to their own health records. Social objects enable patients to share their health experiences in Clinic's social networks. Personal objects empower patients to generate personal health habits. Medical objects enable patients to view their medical records.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by Universiti Brunei Darussalam.

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