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MODELING INTEGRATED MULTI DEVICES E-HEALTH USING XML WEB SERVICE

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ABSTRACT

E-health nowadays has become such trend among IT practitioner. While its implementation in many countries (es-pecially) in Indonesia is so rare, many clinicians and also patients still having hesitation in using it. Reason why e-health is so rarely implemented is just because of digital literacy level for many people in rural area and also clinicians that assume very low. All of those constraints actually can be overtaken using such integrated e-health that will include many devices inside it. This research tried to model that kind of e-health. Integration of e-health should be solved when it useXML Web Service tehcnology, thus its implementation will not bother any actors involved in e-health. Using an architecture diagram to draw big picture of it and break it down into activity diagrams, optimistically it will open new vision about e-health future implementation. And also, there are explanations during its modeling process as long as ethical considerations that must be aware by practitioner if this model will be implemented.

Kata Kunci: E-health, XML Web Service, Modeling

1. INTRODUCTION

E-health nowadays has become such trend among IT practitioner. Especially in developing country like Indonesia, e-health not only becomes another improvement that should increase public service, it also become political issue for government and also political parties to increase their popularity.

On the other hand, the term of e-health is rarely clear defined. Some people said that e-health is only an information system that will connect between patients and clinicians using *new ways* (Rawabdeh, 2007). But it also defined as technology used for clinical, educational, research, and administrative purposes, both at the local site and across wide geographic regions (Harrison and Lee, 2006).

While its implementation in many countries (especially) in Indonesia is so rare, many clinicians and also patients still having hesitation in using it. Both side still thinking that e-health access is dangerous for privacy of patients (Chandra, 2004). This is caused by the way of thinking that e-health will always be put patients' data online and everybody can see it freely.

Surely this view totally wrong because e-health is not just another website that connects both patients and clinicians; however it can be in so many forms of application. As examples are desktop application at hospital, SMS gateway etc.

Another reason why e-health is so rarely implemented is just because of digital literacy level for many people in rural area and also clinicians that assume very low. This analysis is not true after all since that in developing country this barrier can be handled thus e-health will give its optimum functional (Wanjiku, 2004). It also stated that expensive consideration of internet access is one of great constraint to access information in e-health.

All of those constraints actually can be overtaken using such integrated e-health that will include many devices inside it. For example: if an e-health is being implemented at government hospital at first (and as central of e-health), then patients' medical record should also be accessible in a website that can be accessed by private hospital in another area, or private doctor and small health public service (PUSKESMAS=Pusat Kesehatan Masyarakat). Thus, if a patient already is being nursed in one government hospital at a province, then his medical record will be kept alive wherever he got another syndrome. This condition will help doctor at other area to diagnose patient's disease more accurately rather than diagnose it again from beginning.

That condition certainly gives easiness of medical record access, but only if the doctor at other area already has internet access. But what if there is no internet access available at the location? Or the doctor or clinician does not have digital literacy about internet access? This dilemma actually can be solved if e-health is implemented using multi devices concept, thus it will not depend on internet access with PC, but it can be accessible also using another device such as mobile phone application, PDA or SMS that considered give easier access to e-health.

Based on that constraint described, this paper tried to model an integrated e-health that can be accessed through multi devices application. This kind of e-health should be solved using XML Web Service technology that can save bandwidth with its

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disconnected manners. Also it will have global function that would standardize all devices having the same data of medical record.

Thus, after understanding this model, hopefully there will be no more hesitation in e-health implementation that can integrate multi devices application. Furthermore, it can be fundamental model to proceed global e-health integration in a country (especially in Indonesia). Because in developing country like Indonesia, e-health will be very important in order to improve people prosperity mainly in rural areas.

2. LITERATURE REVIEW

2.1 E-health

E-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology (Rawabdeh, 2010).

E-health also defined as electronic transmission, storage and access to data available in digital form for clinical, educational and administrative purposes, both locally and from a distance (Duplaga and Zielinski, 2006). The term itself has also broaden to any electronic exchange of health related data collected or analyzed through an electronic connectivity for improving efficiency and effectiveness of health care delivery (Harrison and Lee, 2006).

While WHO said that e-health applications connect practitioners and clients to primary health centers and connect these centers to referral centers in hospitals for the exchange of data, ensuring access to appropriate, cost-effective healthcare (Cholewka, 2006). Other also said that e-health will always be concerned with business dependency, especially when dot com become dot bomb (Kirsch, 2002).

Despite of its definition, most people assumed that e-health is only medical record that can be accessed through internet (Harrison and Lee, 2006), but it actually more than just "internet and medicine" (Rawabdeh, 2007).

E-health business models include two main parts which are (Rawabdeh, 2007):

1. E-pharmacy
   The business model for the online pharmacy is mainly a virtual business model, whereby revenues are derived directly from the sales of prescription drugs.
2. E-doctor
   E-doctor is a liaison between the patient, local doctors, and medical services

2.2 XML Web Services

A web service is any service that is available over the Internet, uses a standardized XML messaging system, and is not tied to any one operating system or programming language (Cerami, 2002). Web Services expand the Web from a user front end to an application service. Web Services represent a fundamental shift, one that promises tremendous benefits in terms of productivity, efficiency, and accuracy. Indeed, corporate IT organizations are only just beginning to understand the full potential of Web Services (Hartman, 2003).

With Web Services, the originator of a Web connection is no longer just the consumer or supplier of information. The originator can participate in a distributed application environment and issue remote procedure calls to request services. The use of Internet standard protocols and other standards by Web Services allows services to work across diverse environments, solving cross-platform interoperability issues (Hartman, 2003).

The core principles that have driven the design and implementation of the Web services architecture protocols are as follows (Cabrera, 2005):

1. Message orientation
   Using only messages to communicate between services and realizing that messages often have a life beyond a given transmission event.
2. Protocol composability
   Avoiding monoliths through the use of infrastructure protocol building blocks that can be used in nearly any combination.
3. Autonomous services
   Allowing endpoints to be independently built, deployed, managed, versioned, and secured.
4. Managed transparency
   Controlling which aspects of an endpoint are (and are not) visible to external services. Protocol-based integration Restricting cross-application coupling to wire artifacts only.

3. MODEL

One of uniqueness in Indonesia health public service is that a doctor usually works in two different places. He often diagnose patient at hospital or other public health service and then do advanced caring at his own place as private doctor.

This circumstance surely brings another difficulty for both doctor and patient that patient's medical record will be placed in two different locations. As reality already shown that when doctor change his role from hospital doctor into private doctor, they rarely bring their patient medical record. Thus, when a patient come again to the same doctor (after the doctor changes his role) it is very

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possible that the medical record will be start all over again.

This barrier will be handled using e-doctor server that should has private authentication and strict authorization just for responsible doctor who can access patient's medical record. It means that accessing e-doctor server using private web access will guarantee that patient's medical record will be only seen and only read-write just by authoritative doctor and hospital.

On following model figure is shown that patient and also patients' family (in case that patient is not capable to access e-health by himself, for example: children or weak patient) will have various access to e-health. Since that e-health originally thought just a website that provides information about healthcare, pharmacy and online consultation between doctor, pharmacist and patients (Chandra, 2004). But in this model, e-health is far away from that view and broadens its accessibility into multi devices access.

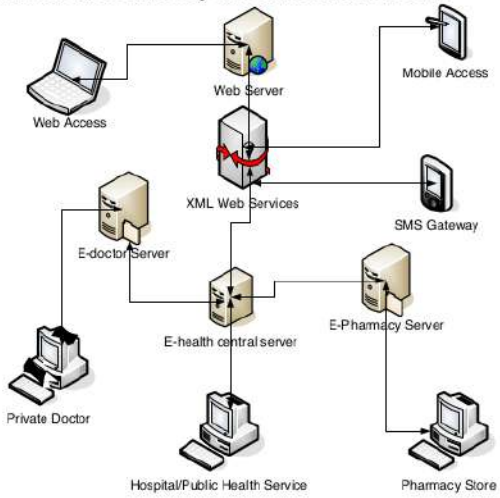

Figure 1. Architecture Diagram

3.1 Web Access

First access, surely, via website that can accessible by three different privilege access which are: health provider (doctor, pharmacist and public health service), patients and/or patients' family, and the last one is unauthoritative guest which become an information searcher in e-health network.

This access will use web server which is filtered previously in XML Web Service server. It means that e-health website will have updated information from e-health central server that comes from aggregated sources. The aggregated sources consist of information from hospital or public health service, private doctor updated information via e-doctor server and also medicine information availability from e-pharmacy server that is updated from pharmacist.

It is assumed that most of e-doctor server and e-pharmacy server are updatable via desktop application and they can use their own platform and programming languages. It means that all data will be standardized in e-health central server using XML Web Service. In other word, e-health central server will be data repository for all data format, which comes from e-doctor and e-pharmacy.

This model will need uniform login that should be ruled by e-health central server. Thus, doctor can access and keep posted medical record via website in any area he can access. It also gives pharmacist at pharmacy store to bring medicine availability easily.

This model is described using activity diagram in following figure:

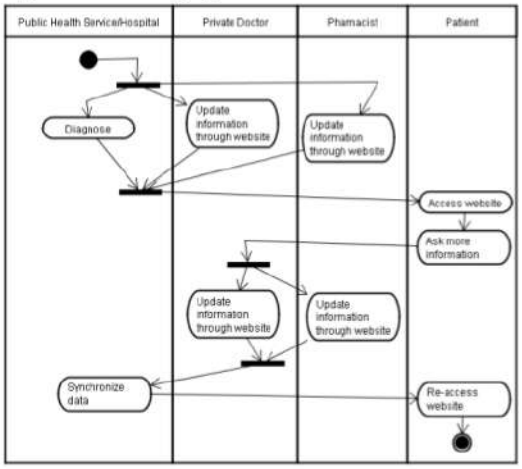

Figure 2. Website Access Activity Diagram

On the other hand, website access must be ruled strictly to guest access since that website will have sensitive information about patients' medical record. But, website will also contain common healthcare information such as disease information, public online consultation and also public health service accessibility. This problem will bring some ethical issues that will be discussed in later chapter.

3.2 Mobile Access

Second access, is using mobile access in this e-health model. Mobile access in this context is e-health access that using PDA and also using mobile phone, either it uses SMS (Short Messages Services) or mobile application.

One of biggest thing that should consider in this access is different data format and application that reside on both PDA and mobile phone. This constraint will be levered by XML Web Services. For example: XML Web Service will have function to change data format from central e-health server (whatever is the format) into feasible format that can be accessed into SMS Gateway. On the other hand,

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it also can have function that will fit into PDA format, whether the PDA is based on Windows Mobile or Palm OS.

Other constraint that should be considered is authorization process that must take uniform login using data from central e-health server. This process will take different step login process compared with website access. While website login process only gives simple user interface, mobile access usually offers login process that needs former registration.

Former registration must be strict to any mobile number that recognized as one of authoritative users, such as doctor, hospital/public health care administration, pharmacist and patients (or patients' family). This procedure should restrict sensitive information from e-health; otherwise it will deal with ethical problems that will be explained in next chapter.

If registration succeeded, e-health central server will keep its data into database. Meanwhile, all data should be synchronized in XML Web Service server when user from previous registration trying to get the data that he wants. Surely, this process still needs another authorization process in order to meet security issue in it.

Important issue regarding XML Web Service in real implementation is how to standardize data format using XML Schema between multi devices. Despite of language programming that will be used in each device, XML Schema that comes from XML Web Service must still have the same standard. This will ease implementation process, since that each device probably comes from different software house or programmer.

In this case, XML Web Service will take central role to manage data traffic while it will not bother the "normal access" in common e-health access. Common e-health access in this context is referring to internet access or website access in e-health. In other word, it will said that whatever access method in this e-health model, it will not worried users and developers.

Since that standardization is important issue, thus hospital or public health service that rule central e-health server must decide standard data format. This rule will be general rule that must be obeyed by other developer that will implement multi devices application.

This sub model is described in activity diagram as following figure:

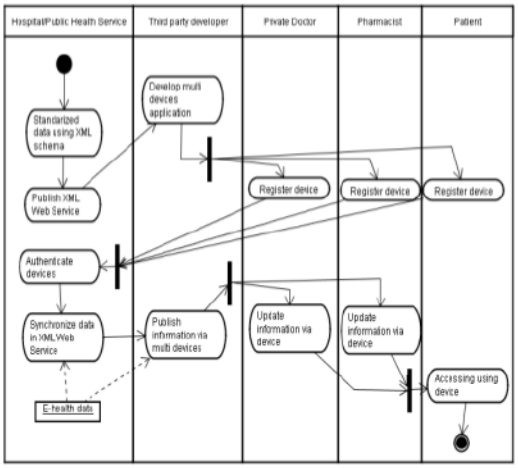

Figure 3. Multi Devices Activity Diagram

4. CONCLUSION AND CONSIDERATION

From description and explanation of e-health model in previous chapter, there should be no more hesitation in implementing integrated multi devices e-health. Especially in Indonesia, where public health service is consist from many forms, whether it is government hospital, private hospital or small public health service such as PUSKESMAS. All of them can access and also update their patient medical record, even if they lack of internet connection.

There are also some advantages when this model is being implemented, which are:

1. E-health implementation is not merely done by hospital or public health service neither of government, it also can be developed by third party developer which is hired by private doctor or pharmacist.
2. Multi devices access will enrich many actors in the model (patient, doctor or pharmacist) in accessing e-health whenever and wherever they are.
3. Updating process from doctor and pharmacist can be done cheaply using multi devices techniques, since that internet connection in Indonesia is not feasible by every doctor or pharmacist.
4. Patient can access their own medical record privately using their own device, thus it will reduce their worries in controlling their own healthcare.

But, there are also some considerations that must be thinked about before implementing this model, which are:

1. There must be standard XML Schema format (not always the same database) that should be ruled by authoritative public health service or

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government to make XML Web Service implementation easier.

2. There must be good socialization or intensive announcement through patient, doctor, pharmacist and other public health service in order to make e-health more useful and being up-to-date.
3. It will also must be think about ethical issue which already become problems in many countries (Goetzinger, 2007). Ethical issue should be solved using good regulation that will assure safety feeling and trust between actors in model. Thus, there will not be high wavering for all users in updating and accessing data from e-health.
4. Authorization and authentication must follow high level security standard, hence it will not worried users. Since that e-health information will contain medical record that considered as private and sensitive information, so privacy will drive great value mostly for patient in accessing e-health (Goetzinger, 2007).
5. Intensive training and open-minded personal for doctor and pharmacist is not merely needed, but it is a great must. Since that both of them are main factor in supporting this model, so their updating contribution will make e-health is not just an unused artifact.

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