CHAPTER 1

INTRODUCTION

Internet is increasingly being used as the main source of health information in Europe and many developed counties, and its perceived importance is increasing. The use of the Internet for health purposes is increasing among all age groups with special strong growth among young women.

According to WHO (Fifty-Eighth World Health Assembly, 2005); e-Health is defined as "…the cost-effective and secure use of information and communication technologies (ICT) in support of health and health-related fields, including health-care services, health surveillance, health literature, health education, knowledge and research..." (p.121).

Researches confirm that internet health users are also using the internet as a communication channel for reaching health professionals and communicating with peers (Kummervold et al., 2008). Electronic health (e-health) term represents healthcare practice supported by electronic process and communication since 1999 (Della Mea, 2001). According to some experts, e-health is interchangeable with health informatics with definition covering electronic/digital processes in health (Blaya, Fraser and Holt, 2010).

Starting from 1990s, e-health has seen by most developed countries as health technologies are not active in less developed countries, their potential has also been recognized in these states. The World Health Organization (WHO) Global Observatory for e-health which aims to supply strategic information and orientation on effective trials, policies and standards for e-health, reports that many less developed countries are understanding and using e-health policy and initiatives (Mars and Scott, 2010).

Since 2011, the increasing need for better cyber-security may result in the need for these specialized resources to develop better e-health solutions that can stay strong against these growing threats (Eysenbach and Diepgen, 2001).

The development of computer technology and its affiliation with improvements in telecommunications has provided the means through and distance delivery of health services that changed radically in recent years. On the other hand, improvements provided by technology brought new solutions to save and disseminate health information. According to

some suggestions, performed developments about e-health, represent unique and most important revolution in e-health systems since the development of modern medicine, vaccines and public health measures like sanitation and clean water supplies (Silber, 2003).

However, there are some barriers to the successful implementation of e-health strategies which have proven difficult to overcome. It has been difficult to make patients understand and use e-health systems because of worries about the protection of personal privacy and etc. At the same time, the full support of healthcare workers has proven difficult to obtain as a result of perceptions that there is not enough clear e-health direction or excessive bureaucratic affect about development of e-health policy. These types of issues are very important; they must be overcome to the satisfaction of all before e-health will be able to fulfill any promises to deliver greater health efficiencies (Thompson et al., 2006).

1.1 The Problem

In terms of healthcare, the Turkish Republic of Northern Cyprus (TRNC) citizens can be examined in state hospitals and governmental health institutions free of charge according to their insurance type by showing their identity cards, healthcare expenses are paid by the government. Civil servants receive this service free of charge and while the ones covered by insurance pay a small amount to receive this service. Those who cannot be treated in TRNC are referred to the Republic of Turkey (TR) hospitals, that is also covered by the government. The electronic collection of patient's data in a single place such as the Ministry of Health is very important in controlling and monitoring of patients in such a system. It will be possible to access any kind of patient's data in the existing electronic environment no matter to which health institution patient goes, and when the e-government system is established, they will be able to receive an appropriate treatment even when information cannot be collected from patients. Only doctors in charge will have access to the patient's information on this system, this is very important for the confidentiality of the patient information (TRNC Ministry of Health Official Website, 2015).

Even though there is a working healthcare system in TRNC but there is no electronic healthcare system exist. Patients cannot communicate with doctors or other departments using electronic means. Patients have to call hospitals or have to go very early in the morning; like 06:00 am in order to secure earlier treatment in state hospitals. A patient has to be physically present in hospital for any simple work like taking test results. This situation creates disturbing crowd in hospitals.

On the other hand, there is no proper communication between state and private hospitals. So, doctors cannot be informed about the history of patients if they don't provide enough information.

1.2 Significance of the Study

This study will be the first example and base for developing architecture of electronic healthcare system in TRNC which covers all private and governmental health organizations to provide online access to doctors and health system workers for any need in order to provide better healthcare, decreasing crowd, waste of time, and waste of materials.

1.3 Aim of the Study

Main objective of this study is creating an e-health system architecture for TRNC which combines all governmental and private healthcare organizations and workers together in electronic environment. Objectives of the system are;

- Ensuring healthcare data standardization,
- Data analysis support and creation of decision support systems,
- Accelerating data flow among e-healthcare stakeholders
- Formation of electronic personal health records,
- Ensuring the resource saving and improving efficiency,
- Coordinating e-healthcare initiative processes,
- Accelerating the adoption of e-healthcare concept in a national sense.

1.4 Limitations of the Study

The architecture which created for this study covers only government hospitals, private hospital and health centers which are active and working in TRNC.

1.5 Overview of the Thesis

Chapter 1: Give general explanations about e-health and the problem definition, the significance of the study, the aim of the study, the limitations of this system and most important breakdown of this study.

Chapter 2: Presents related research work on e-health systems.

Chapter 3: Introduces the theoretical framework whereby various aspects of e-health systems were discussed.

Chapter 4: Explains created architecture of the proposed e-health system for TRNC in with all details, applications, infrastructures and hardware.

Chapter 5: Discussion and conclusion

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CHAPTER 2

RELATED RESEARCH

The studies on recording and keeping the collected patient records in the most reliable way have been going on since 1966s. Method of history not taking and recording reliability and usefulness of the collected data has been analyzed in the most tedious way since then.

Goffman and Newill created a methodology in 1966 for testing and evaluation of information retrieval systems. Many theoretical approaches developed in alien disciplines, revelation from the fact that the final usefulness of an abstract theory can be revealed only in the laboratory, where the degree of agreement between presumption and reality can be measured in terms of quantitative experimental results.

In 1969 Greenes, Pappalardo, Marble and Barnett designed a novel system based on a re entrant high-level language interpreter that allowed the implementation of a high level responsive and flexible system, both for research and development and for economic and reliable service operation.

In 1974, Haessler, Holland and Elshtain provided a research about evolution automated database history. The research conducted by making interviews with totally 7000 patients in 3 years. According to the results, many patients was feeling comfortable with the system.

Duncan, Austing, Katz, Pengov, Pogue and Wasserman created a model 1977 to create a program and provide reports on the current records' status. Researchers worked on and improved a basic program and outlined four different particular parameters and observed their effectiveness.

In 1988, World Health Organization discussed many different options about which informatics and telematics can be used to develop the quality level and prudentiality of services in health sector. Pointing to health managers and professionals, the report combines a definition and explanation of 1988's computer technologies with concrete examples of situations where computers can facilitate managerial tasks better than human. Trials and applications performed about the microcomputer maintenance of medical records in primary health care and mainframe based systems for controlling drug acquisition and distribution at the national level and report brought detailed information about all these processes.

In 1988, Aarts, Peel and Wright presented a model which explains the stages of application of a recording system in a health care organization. Their model does not offer any explanation about the maintenance, but it describes in an order that the fields are appropriate for the system execution. The created model brings a chance to view the missing information in our knowledge and comprehending the maintenance processes. It also provides the theoretic basis for a campus course of health informatics that pinpoints on organizational change and the main role of information and communication technology.

In 1990, Forster studied on informatics with the health and medicine problems elucidated in less developed countries. The author analyzed the capacity of health informatics and defined the points that limit successful applications.

In 1990, Greenes and Shortliffe pointed that the medical informatics is emerging as a basic academic establishment. Healthcare centers started considering great dedications to information systems as that would affect the way of their foundation's function, immensely.

The medical informatics departments have been founded by some of the medical facilities in the United States. Many health care based schools considered same activity and interested in individuals with medical informatics skills by the time.

Kahn, Fagan and Tu pointed in 1990 that database management systems (DBMS) help to physicians to reach information. Also they pointed out that the Time-Oriented Databank (TOD) model was the most useful data model amongst all the medical database systems and it associates with timestamp for every single recording, but the system was not suitable enough for supporting the decision making.

Riva pointed in 2000 that clinic workers and health care providers in demand with a successfully working e-health system that has a compatible connection to the technology, human factors and organizational differences in the composition of the related services. The purpose of the article was evaluating the processes which e-health applications can use for delivery of health services. According to their findings, particular attention is given to shared information as to distributed virtual reality worlds.

In 2000, Yasnoff, O'Carroll, Koo, Linkins and Kilbourne created a system distinguish from other informatics attributions by its focus on objections in populations, use of a wide range of interference to reach its goals, and the limitations of working in a governmental context. The need for created systems appears from improvements in information technology, new

enforcement on the public health system, and changes in medical care delivery systems. Application of the system's principles provides unexpected opportunities to build healthier communities.

In 2005, Michelsen, Pedersen, Tilma and Andersen created an open electronic health retrieval system and has defined the red line in such a way that it makes the generic model small and the domain model large. The information system was large but knowledge model of the system was small. If small information model and a large knowledge model comes together, it makes more of the system changeable, but it also decreases flexibility of development. The opposite scenario is the case for a large information model and a small knowledge model.

In 2005, Świątek and friends pointed that; one of the most important ways to the development of e-health systems is customization.

The authors described some service centered implementations by creating a futuristic electronic architecture that controls the quality of delivery and makes sure that the communication between the parts. It also shows the way that users can benefit from its characteristics such as quality of delivery and available resources. They demonstrated how provided applications straight to the content. They also showed the user consciousness by meanin of the primary next generation network frame as well as the examples of decision-making tasks performed by applications.

In 2005, Bernstein and friends created a system to model and implement electronic health records in Denmark. Integration and acceptable internal operation are prerequisites for a strong and reliable data and the information examples. The National Board of Health was working on an example for electronic health retrieval. Its acceptance was promoted through the studies on preliminary studies.

In the meantime, many development and application projects kept going on throughout the country. These systems were based on the information models of other marketing experts and they were based on different combination platforms. Controllers that have been monitoring the development of electronic health retrieval systems in Denmark analyzed the competition by using various information models and combination platforms.

In 2006, Homer and Hirsch provided system modeling methodology for system dynamics to pinpoint the dynamic complexity which describes public health issues. The system dynamics approach undertakes the development of computer simulation models which show direction to

the process of collecting info and feedback. For prevention of chronic diseases, the system dynamics modeling has to get linked to all the basic features of a modern approach including that disease's outcome, risk behaviors, environmental connections, health associated sources, and the way of delivery. System dynamics promise multiple interacting risk of infections and diseases, the interaction of delivery systems and populations with diseases with regards of the national and state policy.

In 2006, Haux analyzed past, present and future of e-health systems. This research includes much important information about history of health systems and also includes many reliable recommendations for future of the health informatics.

Jha and friends analyzed the use of e-health archives in the United States healthcare facilities in 2009. The research pointed that acceptation of electronic health recording amongst United States hospitals is very few causing the policymakers come across a substantial limitation to fulfill the health care performance tasks that depend on the health information technology. The policy approach focused on the financial aid, internal operation, and educating the technical staff.

Pecht and Jaai presented a paper in 2010 pointing the evaluation of the state of practice in prognostics, health management of information and complex systems. According to the paper, there are two general ways of applying model based and data driven approaches. Authors present a prognostics approach which brings the model based and data driven solutions together to provide a better prognosis.

In 2013, Baig and Gholamhosseini presented a paper which reviews health monitoring systems and a design and system modeling. In the study, presented are the detailed survey of the practicality, clinical reliability, approaches and recommendations on developing the health monitoring systems by the time. Authors reviewed 2013's state of art monitoring systems and the results in the area of smart health monitoring systems. They evaluated, classified, and compared more than fifty different systems. The main improvements in the system design also discussed in the article. Current issues of the year which health care providers were facing and the potential difficulties to health monitoring field were identified and compared to other similar systems.

In 2015, Bielskis and friends proposed a plan in achieving a smart e-healthcare environment by creating a flexible multi agent based e-health and electronic social care system for people

with disabilities. Human-Computer Interaction in the created system provides great e-health care support opportunities for users with movement disabilities through Java based environment; in this system provided is an absolute controllable social care actions by social care robots through the system for people with movement disabilities in real time.

Stanimirović conducted a research in 2015 based on a single explanatory case study design. It was planned through the interviews with 15 experts from the Slovenian healthcare system. Results provided that worthy insights into the operative, constructive, and application aspects can be conditional to intelligent coordination with other environmental factors and structural reforms pending for providing better operation to public healthcare resources.

In 2016, Corey and friends carried out a research to identify non-traditional cardiovascular risk factors in nonalcoholic fatty liver disease by using electronical medical records database and provided detailed results with advantages of e-health systems.

Lialiou, Pavlopoulou and Mantas applied a cross-sectional survey in 2016 to determine usage of online IR Systems and online evidence by health professionals. The research conducted in Greece and totally 439 nurses and physicians from public and private hospitals attended to the survey. According to results, common reasons for using online information systems is conducting scientific researches and filling a knowledge gap. Also 90% of attendants think that using online e-health systems improves patient care.

CHAPTER 3

CONCEPTUAL FRAMEWORK

3.1 Network

A computer network or in another words data network is creating connection to allow computers to exchange data. In computer networks, connected devices exchange data by using a data link. The connections between computers, in other word nodes, can establish by using cable or wireless. The most popular computer network is the Internet (Tanenbaum, 2003).

When computers invented during Second World War, they cost extremely expensive and isolated from public use. But 20 years later, computer prices decreased and engineers started to make experiments to connect computers to each other in order to share data and information digitally (Bonaventure, 2011). Computer networks allow multiple hosts to exchange data and information between connected devices. To give permission to any host to send data or information to any other point in the network, organizing them as a full-mesh is the easiest way (Peterson and Davie, 2007).
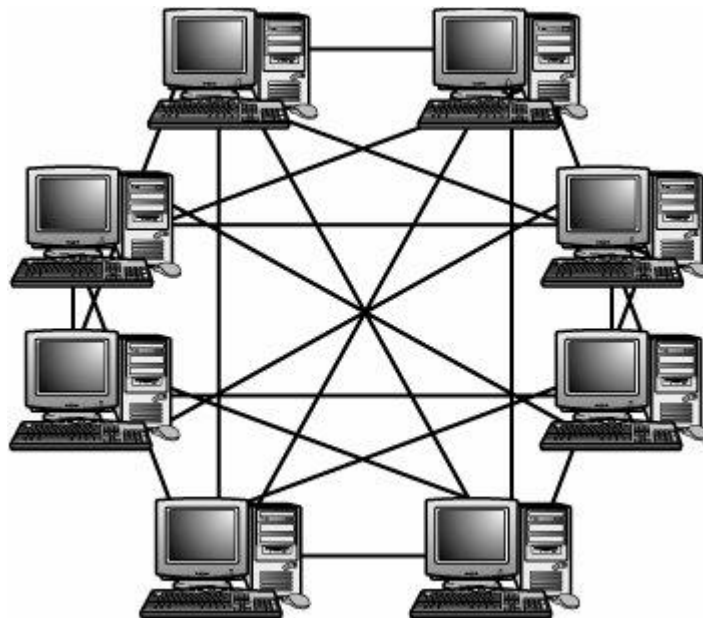
Figure 3.1: Full mesh network topology (Farag, Funabiki and Nakanishi, 2009)

3.1.1 Fiber optic and digital subscriber line (DSL) communication

Fiber-optic communication is a method to transfer data or information from one node to another node by sending light pulses through an optical fiber (Yasin, Harun and Arof, 2012). DSL is the collection of related technologies which are used to transmit data or information by using telephone lines (Bourne and Burstein, 2002).
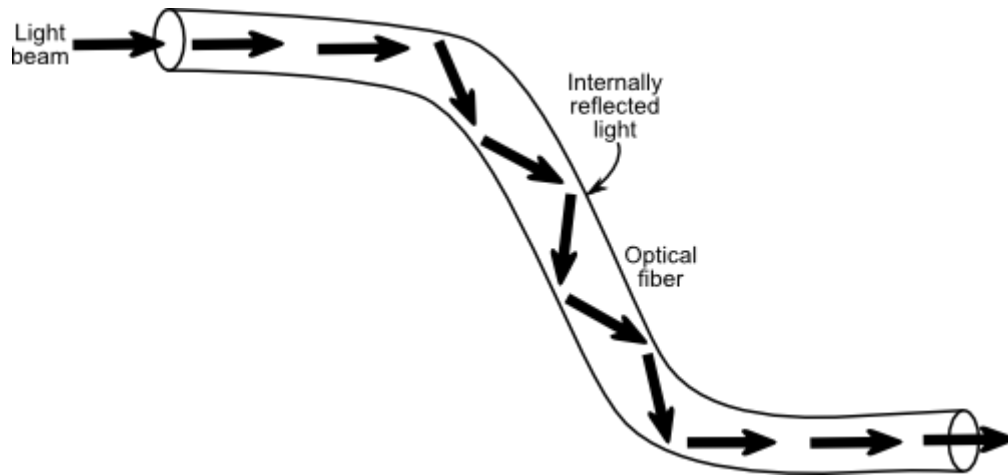

Figure 3.2: Movement of light pulses in fiber optic cable (Yasin, Harun and Arof, 2012)
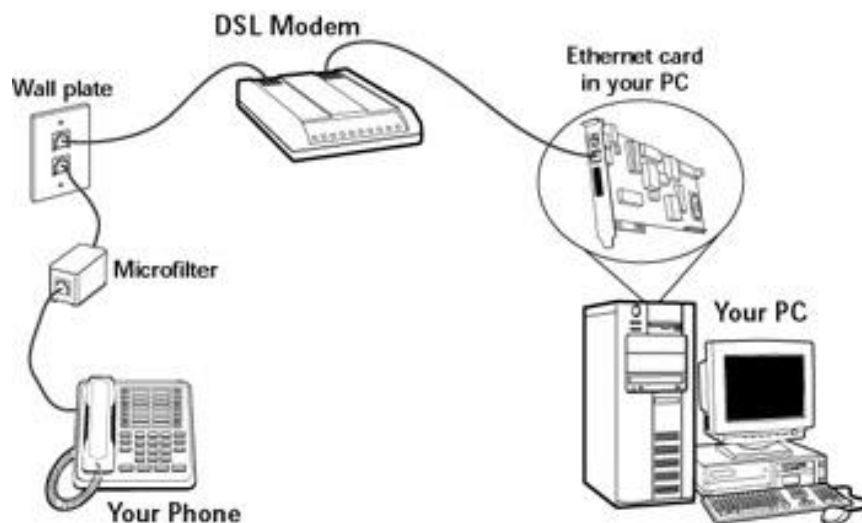

Figure 3.3: How DSL connection works (Bourne and Burstein, 2002)

Speed and performance of both connection opportunities is depending on location. Fiber optic connection may provide higher speed with correct configuration settings while performance must be superior with fiber optic connection. On the other hand, DSL connection may cause slower connection performance (Park et al., 2004). If there is a fiber optic facility in the area, cost will be nearly equal with DSL service packages. Otherwise, fiber optic packages will cost much more than DSL. However, DSL prices can be very high if it is the only option in the area. But generally DSL connection is less expensive choice, which is depending on how much speed you need (Lin, 2006). Fiber optic connection is faster, more reliable, private and safer while DSL connection has higher availability and lower price (Sarkar, Dixit and Mukherjee, 2007)

3.2 Information Retrieval Systems

Information retrieval (IR) term represents searching items and it is directly related with the representation, data storage, and access to information as a result. On the other hand IR is a data retrieval, document retrieval, and text retrieval but each of them has its own of literature. IR is multidisciplinary area and it is related with science areas like computer science, mathematics, library science, information science, information architecture, and etc. Automated IR systems are used to reduce the information overload. Web search engines are most popular IR applications (Bouadjenek, Hacid and Bouzeghoub, 2016).

IR systems are designed to reach all relevant information on databases by eliminating irrelevant documents (Tonta, Bitirim and Sever, 2002). An IR system reaches relevant information by using probabilities. To provide an information retrieval, the IR system uses all prior probability that a document is relevant independent of the query and the probability that the query always generated by a single document given that the particular document is relevant at the same time (Salton, 1983). An IR system must use two conditions to access the requested information from the database. Firstly, terms should be suitable with the indexed documents or other objects. Secondly; entered keywords should match with the indexed objects and documents. If requested information is not entered to the database, IR system cannot retrieve it (Lawrence and Giles, 1999). During information search, the IR system has a Retrieval Rule that can be defined as; for every query, system should retrieve information from the indexed objects/documents and their sub-indexes. Starting from this point, main components of IR systems are defined as follows (Townler, 1976):

1- Indexed documents or their equivalents.

2- User friendly interface.

3- A Retrieval Rule for the comparison of the queries and indexed documents or objects for the IR. Another important point of IR system is a user group is needed to perform searches on the IR system (Maron, 1984).
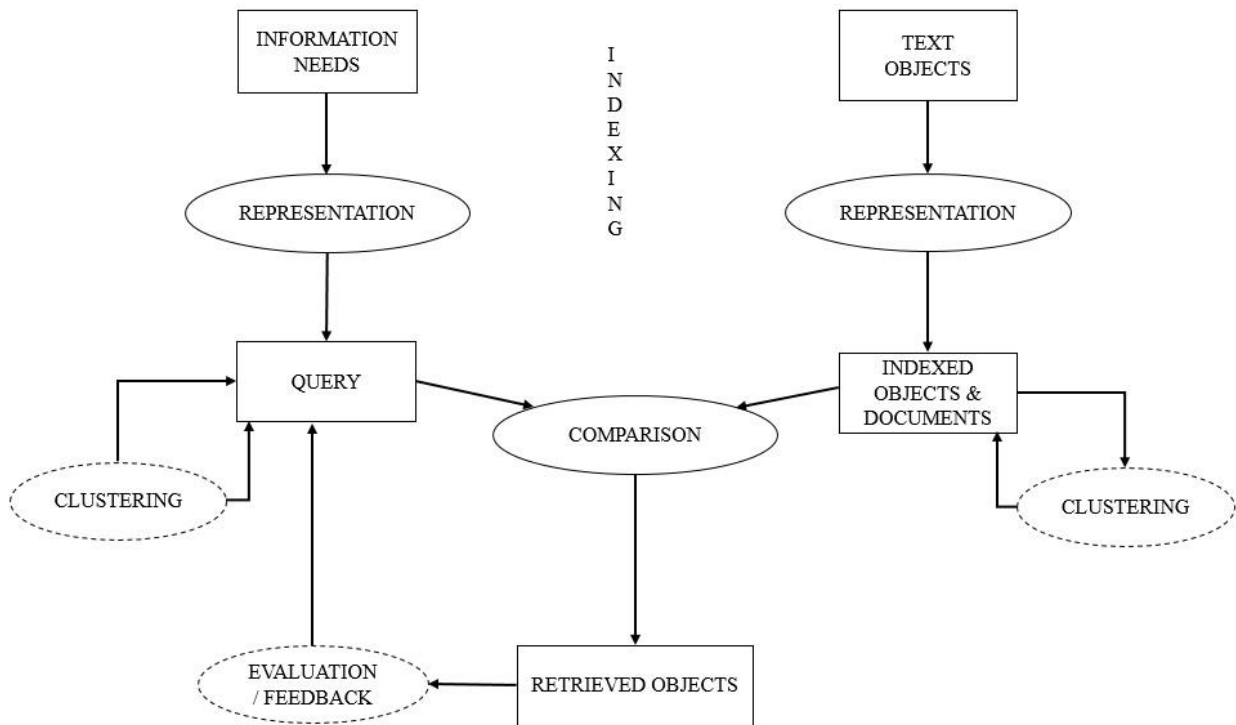
Figure 3.4: Representation of traditional IR system (Bitirim, Tonta and Sever, 2002)

Figure 3.4 explains the architecture and working terminology of a traditional IR system. Retrieval process can be defined with three front-end and three back-end concepts which form the IR system. In the figure, items are represented by rectangles and process phases are showed by dashed ovals. Front-end part of the figure shows the external world part of the IR system. Back-end part of the system is transparent to the user and it is used for the communication between retrieval processes. Information need, text objects and retrieved objects are the front-end parts of the system. Back-end parts are queries, indexed objects/documents and terms (Bitirim, Tonta and Sever, 2002). Information need can be words or sentences by using "and", "or", "not", "if", etc. Text objects forms an entrance to automatic indexing process and results are shown as subjective in inverted file arrangement. In here, presentation of objects with terms shows diversity. A document can be shown in

different ways and truly, it doesn't matter if indexing is done automatically or manually. At the end of the search process, retrieved objects are listed according to relevance of information need. In another words, retrieved objects are arranged in form of list which forms the retrieve function (Bitirim, Tonta and Sever, 2002).

3.3 Electronic Health Record

Electronic health record (EHR), terms refers to the systematically designed collection of patients and diseases data which store health information electronically in a digital format (Gunter and Terry, 2005). All records can be shared between different health care settings. Records are shared according to network-connection, wide information systems of enterprises or other information networks and exchanges. EHR can contain a range of data, including demographics of diseases or patients, medical history, medication and allergies of patients, test results, radiology or x-ray images, vital signs, statistics like age, height and weight, and billing information (Demiris et al., 2008).

EHR systems store data correctly and capture the state of a patient in time. So there is no need to track down patient's previous papers, medical records to ensure that data is accurate and legible. EHR is capable to reduce risk of data duplication as there is only one modifiable file, which means that file is updated and there is an important decrease in paperwork. Because of digital information is searchable in a single file, Electronic Medical Record (EMR)'s became into more effective and important during extracting medical data to examine possible trends and long term changes regarding a patient. Population based researches of medical records can also be facilitated by the widespread adoption of EHR's and EMR's (Habib, 2010).

3.3.1 Technical features

There are 5 important technical features about health information systems in concern:

- Digital formatting which allows information usage and sharing over secure networks.
- Data tracking and information output.
- Trigger warnings and reminding options
- Sending and receiving orders, reports, and results
- Decreasing billing process time and creates more trustworthy billing system (Schumaker and Reganti, 2014)

Figure 3.5: Example for work procedure of EHR Systems (www.healthrecordsystem.com)

3.3.2 Health information exchange

Technical coverage enables information to move digitally between organizations and provides reporting option beside e-Prescribing while sharing laboratory results or etc. Using EHR to read and write a patients' records is possible through a workstation but according to the type of system and health care options, it is also possible through mobile devices such as tablets and smartphones which has handwriting option (MacKenzie and Soukoreff 2002). Electronic Health Records can provide and include access to Personal Health Records (PHR) and also makes individual notes from an EHR quickly visible and accessible for customers (Terry et al., 2008).

Some EHR systems monitor clinical events automatically and analyze patient data from an electronic health record to expect, find and prevent events. This situation can include billing information, pharmacy orders, x-ray and radiology results, laboratory results and any other data from provider notes (Herwehe et al., 2012).

EHR's also help to improve care coordination. Well-designed EHR may view the patient's all charts, which cuts down on guessing patient histories, seeing more than one specialist, ease transition problems between care settings, and also possible to provide better care in emergency situations (Jha et al., 2009). EHRs may also improve prevention by providing doctors better access to detailed patient records (Krist et al., 2014).

3.3.3 Customization

Each healthcare environment function works differently and often it has significant ways. It is highly difficult to create an EHR system which suits to all healthcare units. For example, some of the first generation EHRs were designed to fit the satisfy primary care physicians, leaving certain specialties significantly less satisfied with their EHR system (Blumenthal and Tavenner, 2010).

An ideal EHR system should bring some standards to records but user interfaces can be arranged according to each provider environment or end user request. Modularity option of EHR system provides this opportunity and many EHR companies hire vendors to make customization. This customization can be request often and done because physician's input interface may be similar with previously utilized paper forms. On the other hand, users reported negative effects about communication, increased overtime, and missing records because EHR system was not utilized (Maekawa and Majima, 2005). Customizing the software provides highest benefits from the system because it is adapted for the users and designed again to workflows specific to the institution (Tüttelmann, Luetjens and Nieschlag, 2006).

Customization may have some disadvantages like higher costs involved to implementation of a customized system initially. On the other hand, it needs more time to spend by both the implementation team and the healthcare provider to understand the needs of workflow. Development and maintenance processes of these interfaces and customization steps can also lead to higher software implementation and maintenance costs (Gao et al., 2007).

3.3.4 Long-term preservation and storage of records

One of the important considered points in the process of developing e-health records is how to plan for the long-term preservation and storage of these records. The area will need to come to common decisions about how long system will store EHRs, possible methods to guarantee the future accessibility and compatibility of stored data with developed retrieval systems in future, and how to guarantee the physical and virtual security of the archived data. Also, considerations about storing data of e-health data for a longtime are complicated by the chance that the records may one day be used completely and integrated across sites of care. Recorded e-health data have the potential of creating, used, edited, and viewed by multiple independent entities. All these entered data includes data bout patients, physicians, hospitals and insurance companies. Researchers have noted that many selections about the architecture

and ownership of e-health records will have profound impact on the accessibility and privacy of patient information (Mandl, 2001).

The required length of storage for private e-health record depends on national and state policies which are subject to change over time. Researchers have pointed that the standard preservation time of patient data varies between 20 and 100 years. As an example of how an EHR archive may function, researches explains a combined Trusted Notary Archive (TNA) which receives health data from many different EHR systems, combine data together with attached meta information (information about information) for long time period and distributes EHR data objects. TNA is able store objects in Extensible Markup Language (XML) format and indicates the integrity of stored data with the help of action records, time stamps and archive electronic signatures (Ruotsalainen and Manning, 2007).

Also, TNA archiving described by researchers as other combinations of EHR systems and archive systems are possible. All other requirements for the design and system security and its stored data will vary and has to function under ethical and legal policies which are specific to the time and place (Mitty et al., 2001).

Actually it is unknown precisely that how long EHRs will be preserved. It is certainly sure that length of time will be much more than average shelf life of paper records. The development of technology is such that the programs and systems may input information will not be available to a end-user who will need examine archived data. Another way of solution to the challenge of long term data accessing and usage of data by future systems is to create standard information fields in a time fixed component way, such as with XML language. Researchers pointed that basic XML format has endure primary tests in Europe and it is suitable for purposes of European Union (Chokhani and Wallace, 2004).,

3.3.5 Synchronization of records

When patient receives health service from two different facilities, it can be difficult to update records at both hospitals in a combined fashion. There are two models to ease this problem. One of them is centralized data server solution and the other solution is peer-to-peer file synchronization program if the system has been developed for other peer-to-peer networks (Papadouka et al., 2004)

Synchronization of programs and systems for distributed storage models are useful for only once record standardization has placed. Combining of existing public healthcare databases is the main software challenge. The capability of e-health record systems to provide this option

is a key advantage and can improve healthcare delivery to better conditions (Williams and Hollinshead, 2004).

3.3.6 E-Health and teleradiology

Common usage of patient information between different health care organizations and IT systems differs between point to point and many to many models. The European Commission always supports moving to facilitate cross border internal operation capability of e-health systems and to eliminate potential legal problems. To create and work with global shared workflow, studies will be in dead end when they are being read and then unlocked and updated once reading is complete.
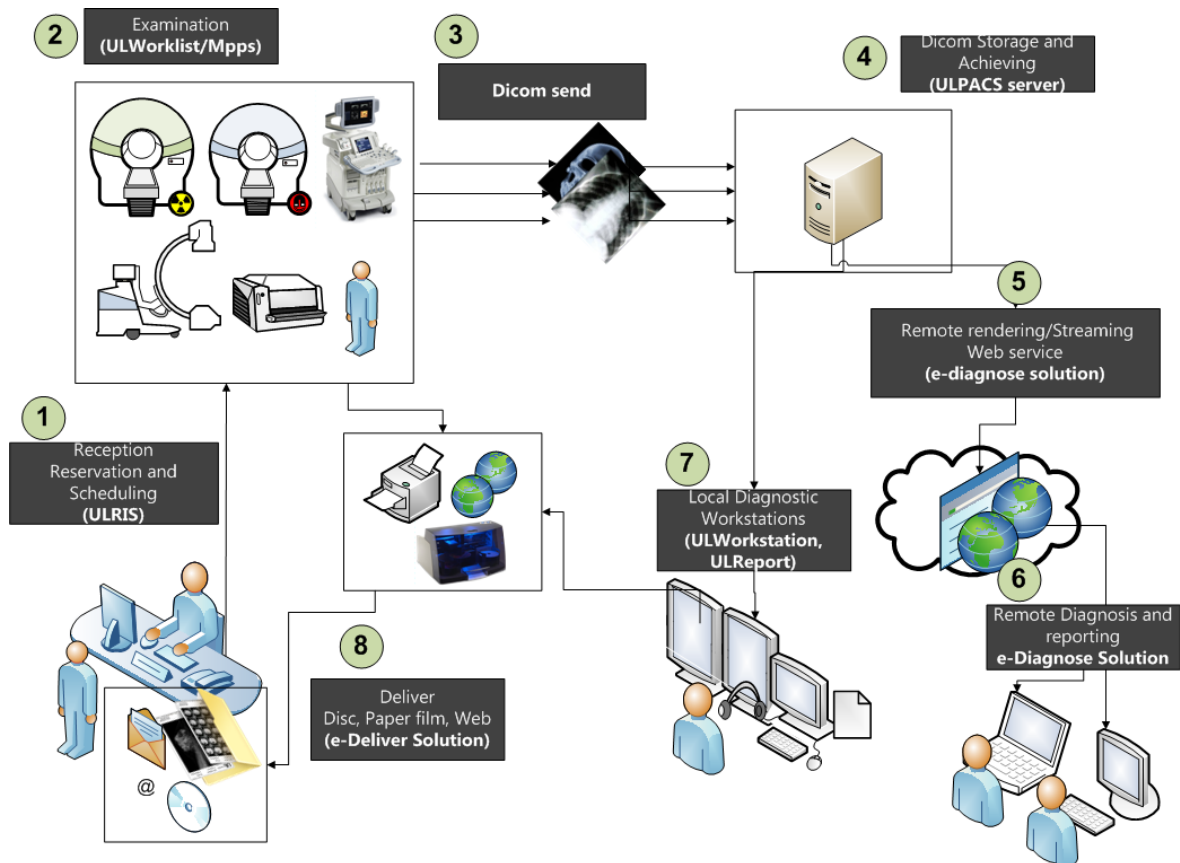
Figure 3.6: Example for teleradiology workflow (Kenny and Lau, 2008)

Radiologists will have opportunity to serve more than one health care facilities and works across large geographical areas, thus balancing workloads. The biggest confessed difficulties will be related to inter-operability and legal clarity. In some undeveloped countries it is nearly forbidden to practice tele-radiology. When many languages are spoken in a country forms a

real difficulty in reporting in more than one language templates for all anatomical regions which are not yet available. However, the market area for e-health and tele-radiology is developing faster than any laws, policies or regulations (Pohjonen, 2010).

3.4 Barriers to Adopt EHR Systems

Among the pointed barriers facing adoption are:

- It has high capital cost and poorly return on investment for small organizations and safety net providers.

- Not understanding and underestimated organizational capabilities requires changes in management.

- Failure to design clinical process and workflow to incorporate the technology systems.

- Legal issues and regulations will become illegitimate.

- Not enough qualified resources for implementation and support.

- Current systems don't meet the needs for rural health centers

- Negative concerns about adoption of technology.

Understanding and recognizing the importance EHRs about transforming health care, National Academy of Medicine created eight key functions for quality, safety and care efficiency that EMRs has to support for successful application. These key functions are listed follow:

1- Physician has to access to information about patient like diagnoses, allergies, lab results, medications etc.
2- Having access opportunity to new and previous test results from providers who works in more than one care settings.
3- Computer based order entry from provider.
4- Computer based decision support systems to inhibit mutual drug interactions and develops compliance with best practices.
5- Creating secure digital and electronic communication between providers and patients.
6- Patients must have access to their own health records, possible disease management tools and resources about health information.

7- Computer based administration phases like scheduling systems.

8- Electronic data storage and reporting about patient safety and disease surveillance efforts according to the standards.

3.5 Hospitals and Health Centers in North Cyprus

There are a total of 44 hospital and healthcare centers in North Cyprus of which 12 private and 32 state healthcare centers. State hospitals have 1052 bed capacity and private hospitals have 641 bed capacity. State hospitals give service with 304 physicians and private hospitals give service with 446 physicians. Also North Cyprus healthcare centers has totally 1635 workers and 775 of them belongs to state centers.

3.5.1 E-Health systems in north cyprus

There is freedom of patients to choose a doctor in North Cyprus. They can go to any doctor at any government hospital as they desire by taking an appointment through the treatment system.

Northern Cyprus has no central e-health system that is currently being used. All healthcare centers have their own system and there is no information sharing between them since these systems are not interconnected.

In both government and private healthcare centers in North Cyprus. Because patients have freedom to choose their hospitals and doctors, if patient is not pleased with the service provided by a doctor or a hospital, they may take appointment from another hospital. Changing to another hospital with no pervious record of the same patient may causae problems particularly in case of emergency for the same patient.

 Before diagnosis or giving medication, it is important to receive detailed information from patients about their medical and medication history (Risse and Warner, 1992). Because all patients are not well informed about importance of clinical patient history, some of them may give insufficient information to doctors and this situation may cause wrong diagnosis or wrong medical treatment (Rensimer, Tomsovic and Wright, 1998). Hospitals' EHR systems are not interconnected in North Cyprus that may cause similar difficulties to occur in case of insufficient of lack of information.

CHAPTER 4

INTEGRATED E-HEALTH SYSTEM FOR NORTH CYPRUS

To create an interconnected EHR system for North Cyprus, firstly a data bank will settle in ministry of health building and all hospitals and healthcare centers will be able to reach information from this data bank by fiber optic connection. Health care centers, dispensaries and private hospitals will connect to city hospitals by Asymmetric Digital Subscriber Line (ADSL) line by opening a Virtual Private Network (VPN) or Wireleless Network Connection. Wireless Network Connection is expensive and brokeble some windly wheathers.

4.1 Hardware

4.1.1 Devices and materials required for the system room to be installed:

- The proposed system consists of 3 servers or 3 physical machines in a blade server.
- A web and 1 database server will work in a wmware environment on each server. A server will stay in the system as online spare.
- The number of web server can increased according to the increase of user number. All these serversare able to share the internet traffic by a Domain Name System (DNS) Round-Robin and a load balancing device to be placed in the front.
- DB servers will be configured together as cluster.
- All the data on the servers can be kept on a flash storage connected to a fiber channel in the background or on a SSD caching storage.
- There are 2 San switch between the servers and the storages and each device must be connected to these two switches by a cable.
- All the data on the DB servers are replicated on a disaster site in another location by a data replication license and software.
- A web server and a database server are going to be available on disaster site. A connection between two locations may establish with high availability.
- If two storage can work as network mirrors between each other, it might be a safer environment even if the cost increases. This aspect should be considered.
- The back-up of the system may be carried out by Veeam if required and it can be replicated in a distant location. This type of license is available in wmware alternatively.

- System backups can be made on tape library with autoloader or on a cheap anti-QNAP NAS device.

A blade server is a simple server with a modular design optimized in order to minimize the physical space and energy use. While a standard rack-mount server can work with an electric and network cable, many components of the blade server has been removed in order to save space and power consumption. Blade enclosure that contains many blade servers provide the energy, network connection, cooling and management services to the inside servers. The whole consisting of an enclosure and blade servers which called a blade system.

It refers to the minimum height (4.45 cm) that a 1U server will cover in the standard rack servers. The height of the standard cabins used is 42U which means that they can contain a maximum of 42 servers. However, it is possible to increase it to 128 servers in a cabinet by using blade servers.

4.1.1.1 Blade case

Blade enclosure offers the services to the basic functions commonly to all the blade servers. These services are used highly under the capacity in the non-blade systems, so it stays as idle in a large capacity as well as creating an unnecessary cost and heat. Providing these services from a single point ensures the effective use and reduces operating and ownership costs.

Figure 4.1: Blade case example

- Power: Two power sources are available in most of the entry level servers today for interrupt ability. Idle power source both uses electricity and cause an increase in the temperature of environment.
- Cooling: Electronic and mechanical components produce heat when the computer is running. For the stable running of the system, the heat must be given off through the fans. Blade systems generate less heat compared to equal number of servers due to common power usage and therefore requires less cooling.
- Network: Today's computer work faster with increasingly integrated network components. However, this bandwidth is not used effectively and it is often remained idle. In addition, a complicated layering is required. The network need of many servers are consolidated with blade enclosure and it may be provided over a single network cable when necessary.

a) Blade servers and their advantages

To explain briefly, Blade Enclosures and Blade Servers are integrated environments which are called differently by the producers (such as Blade System c-Class, BladeCenter E, H), designed to decrease the total and initial owning costs of the servers, configured on current and new blade server hardware and additionally containing software, service, network and virtualization tools.

The most obvious advantages of high efficiency and blade architecture are observed in institutions with virtualization infrastructure.

Blade Systems offer advantages such as high hardware intensity that they can reach, less space coverings, instant function change, ability to intervene in the hardware without shutting down the entire system, fully redundant power supplies, fans, network interfaces and data paths as well as the advantages of flexible processing power and memory pool integrated with the virtualization infrastructure.

b) Brief disadvantages of blade systems

- Limited disk space
- Not using cards of rack-mount servers, limited PCI card support

4.1.1.2 Fast and easy configuration

The most significant features of Blade servers compared to rack/tower-mount servers are their evident physical and administrative conveniences at the intervening / maintenance phase to the failure during and after the configuration. Any blade server included in the virtual pool in a virtualized environment can be removed without removing enclosure, without stopping the power and without interfering in any connection, can easily be transferred to other servers through the virtualization software of all the load on the server and can perform the intervention / maintenance faulty parts.
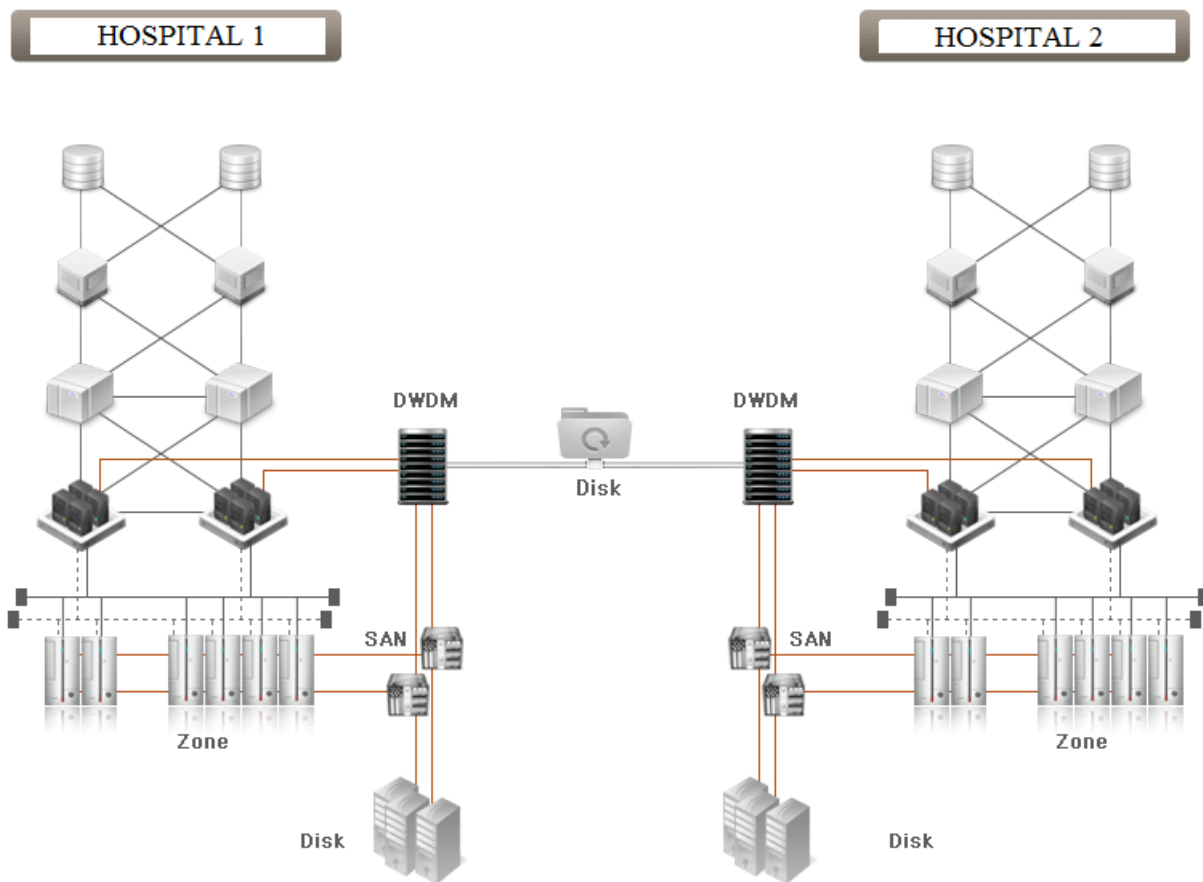
Figure 4.2: Example for connecting two hospitals by blade case server

Nearly all processors, memories, 2.5 inch disks and connectivity options that server rack and tower-mount servers have are available in blade servers. The main factors that decrease the initial owning cost in such case where there are so many similarities are as follows;

- Server with smaller case and lower cost
- Unavailability of power supplier and fan unit on the server
- Server that obtains the service of the self-run/management component support over the enclosure instead of itself

Referring to the low initial ownership costs, these issues must never be forgotten, as the common components in the blade enclosure and the cost of enclosure are encountered in addition to the costs of blade servers, encountering a lower initial ownership cost than same/similar rack-mount servers and considering it as an option would be possible only if 6 or more blade servers are purchased. Otherwise, as the cost of the blade enclosure components will be shared by a low amount of servers, it would not be possible to have productivity in terms of quantity and processing power / price ratio.

4.1.2 Data storage

The population of TRNC is 313,616 (TRNC State Planning Organization Statistical Book, 2015).Calculations are based on citizens: If an MR image is considered to be 450 MB, every individual needs a space of 500 GB (It may be increased). According to this calculation, a total space of 2 TB is needed. This large data can be decrypted by 23 Seagate Business Storage 8-Bay Rackmount NAS. Each Rackmount occupies 1U shelf. In addition, this should be multiplied by 2 in order to ensure the safety (Mirror). After connecting these NAS to a Blade server and connecting this server to the others, Data Storage part will be ready to use.

4.1.3 Low operational cost

Blade servers can be operated at a low cost in terms of management and consumption. Time spent for administration and labor force has been reduced by virtue of the convenience by centralized management and intervention. Common power supplies and fans are switched on and off according to the load condition in the enclosures, similarly if the servers included in the pool are no longer required, the operation of the machine with idle processing power and available memory by virtue of virtualization. In case of failure, waste of data and time has been reduced to a minimum as a result of the intervention convenience and loss in terms of labor work and finance has been avoided.

4.1.4 Much work in a confined space

The quantity of blade servers to be stored in a rack cabinet changes depending on the producer and it is approximately 50 servers. A half size blade server with two sockets equals to 2U and a rack-mount server with two sockets is considered, the required space to contain 50 servers increases to three 42U rack cabinets. Saving a space up to 60% in the system room proves the intensity and the effect of the architecture of the blade servers and the efficiency of the blade servers.

4.1.5 High performance and compatibility in virtualization and consolidation projects

When it comes to scalability, the first thing that comes into mind is the blade serves on which the definition of scalability can be fully implemented are indispensable for the virtualization and consolidation projects. When virtualization is considered within a "pool" logic in which the pool must be flexible, it ensures the high flexibility, high availability, high redundancy and high scalability terms in this type of projects because of presenting modular structures, more processing power in less space and memory space and it is seen as an appropriate platform. Even though it is possible to perform a similar and / or higher-performance virtualization projects by using rack-mount servers, this type of servers are contrary to the principle of virtualization of performing more work with less resources and today, it is discernibly giving way to the blade architecture. All of today's major manufacturers of blade system operate 100% compatible with Hyper-V, VMW as well as XenServer platforms and support these technologies.

4.1.5.1 A regular system room where the cables are out of sight

When a blade enclosure is purchased, it generally contains the following components based on the project requirements;

- Blade Servers
- SAN modules
- Network modules
- Power supplies
- Fans

All components in rack-mount systems mentioned in the enclosure above occupy space separately, and they must separately be wired, cooled and receive power with backup. No matter what the quantity of servers exist in the blade systems, power is only provided for the enclosure, it is sufficient to cool the enclosure only, and all the network and SAN have ports on the enclosure with backup. In case of any failure, an entire server can be included/removed in the system and maintained with a process not more difficult than inserting a disk to the server away from clutter, without even interfering with the wiring in the rear of the enclosure. There will not be any need to get lost among cables after the intervention and to deal with dozens of cables and any physical limitations in order to add 2 more servers to 10 servers that are already used.

4.2 Software

Software will be needed to establish a connection between the networks we have established. Therefore, in order to save time and shorten the software processing the proposed system consists of the following LAMP:

Operating System: Linux for Server, Windows for users, Http (Hypertext Transfer Protocol): Apache Http Server, Database Management System: MySQL and Programming Language: PHP (Hypertext Preprocessor).

But you do not need to use LAMP only. Alternatively, it would be much more useful to use oracle on the wisdom databases if there is no change in the operating system. We need to propose javascript in the software. Even using JavaScript instead of php may be more useful for this project.

4.2.1 Lamp

LAMP is an acronym for an classical model of web service solution stacks, originally consisting of largely identical components: Linux, the Apache HTTP Server, the MySQL relational database management system, and the PHP programming language. As a solution stack, LAMP is suitable for building dynamic web sites and web applications.

The LAMP model has since been adapted to other componentry, though typically consisting of free and open-source software. As an example, the equivalent installation on a Microsoft Windows operating system is known as WAMP.

Originally popularized from the phrase "Linux, Apache, MySQL, and PHP", the acronym "LAMP" now refers to a generic software stack model. The modular componentry of a LAMP stack may vary, but this particular software combination has become popular because it is entirely free and open-source software.

4.2.2 Linux

Linux is a Unix-like computer operating system assembled under the model of free and open source software development and distribution. Most Linux distributions, as collections of software based around the Linux kernel and often around a package management system, provide complete LAMP setups through their packages. According to W3Techs in October 2013, 58.5% of web server market share was shared between Debian and Ubuntu, while RHEL, Fedora and CentOS together shared 37.3%.

4.2.3 Apache

The role of LAMP's web server has been traditionally supplied by Apache, and has since included other web servers such as Nginx.

The Apache HTTP Server has been the most popular web server on the public Internet. In June 2013, Netcraft estimated that Apache served 54.2% of all active websites and 53.3% of the top servers across all domains. In June 2014, Apache was estimated to serve 52.27% of all active websites, followed by nginx with 14.36%.

Apache is developed and maintained by an open community of developers under the auspices of the Apache Software Foundation. Released under the Apache License, Apache is open-source software. A wide variety of features are supported, and many of them are implemented as compiled modules which extend the core functionality of Apache. These can range from server-side programming language support to authentication schemes.

4.2.4 Mysql

MySQL's original role as the LAMP's relational database management system (RDBMS) has since been alternately provisioned by other RDBMSs such as MariaDB orPostgreSQL, or even NoSQL databases such as MongoDB.

MySQL is a multithreaded, multi-user, SQL database management system (DBMS), acquired by Sun Microsystems in 2008, which was then acquired by Oracle Corporation in 2010. Since its early years, the MySQL team has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietaryagreements.

MariaDB is a community-developed fork of MySQL, led by its original developers. PostgreSQL is also an ACID-compliant relational database, unrelated to MySQL.

MongoDB is a widely used open-source NoSQL database that eschews the traditional table-based relational database structure in favor of JSON-like documents with dynamic schemas (calling the format BSON), making the integration of data in certain types of applications easier and faster.

4.2.5 Php

PHP's role as the LAMP's application programming language has also been provisioned by other languages such as Perl and Python.

PHP is a server-side scripting language designed for web development but also used as a general-purpose programming language. PHP code is interpreted by a web server via a PHP

processor module, which generates the resulting web page. PHP commands can optionally be embedded directly into an HTML source document rather than calling an external file to process data. It has also evolved to include a command-line interface capability and can be used in standalone graphical applications.

PHP is free software released under the PHP License, which is incompatible with the GNU General Public License (GPL) due to the PHP License's restrictions on the usage of the term PHP.

Perl is a family of high-level, general-purpose, interpreted, dynamic programming languages. The languages in this family include Perl 5 and Perl 6.

They provide advanced text processing facilities without the arbitrary data-length limits of many contemporary Unix commandline tools, facilitating manipulation of text files. Perl 5 gained widespread popularity in the late 1990s as a CGI scripting language for the Web, in part due to its parsing abilities.

Python is a widely used general-purpose, high-level programming language. Python supports multiple programming paradigms, including object-oriented, imperative andfunctional programming or procedural styles. It features a dynamic type system, automatic memory management, and a standard library. Like other dynamic languages, Python is often used as a scripting language, but is also used in a wide range of non-scripting contexts.

4.2.6 Java script

JavaScript is a high-level, dynamic, untyped, and interpreted programming language. It has been standardized in the ECMAScript language specification. Alongside HTML and CSS, JavaScript is one of the three core technologies of World Wide Web content production; the majority of websites employ it, and all modern web browsers it without the need for plug-ins. JavaScript is prototype-based with function literal, making it a multiple first language, supporting object-oriented, optional, and functional programming styles. It has an API for working with text, arrays, dates and regular expressions, but does not include any I/O, such as networking, storage, or graphics facilities, relying for these upon the host environment in which it is embedded.

Although there are strong outward similarities between JavaScript and Java, including language name, syntax, and respective standard libraries, the two are distinct languages and differ greatly in their design. JavaScript was influenced by programming languages such as Self and Scheme. Although there are strong outward similarities between JavaScript and Java, including language name, syntax, and respective standard libraries, the two are distinct languages and differ greatly in their design. JavaScript was influenced by programming languages such as Self and Scheme.

JavaScript is also used in environments that are not Web-based, such as PDF documents, site-specific browsers, and desktop widgets. Newer and faster JavaScript virtual machines (VMs) and platforms built upon them have also increased the popularity of JavaScript for server-side Web applications. On the client side, developers have traditionally implemented JavaScript as an interpreted language, but more recent browsers perform just-in-time compilation. Programmers also use JavaScript in video-game development, in crafting desktop and mobile applications, and in server-side network programming with run-time environments such as Node.js.

4.2.7 Oracle

Oracle Database (Oracle or Oracle RDBMS) is an object-related database operation system generated by the Oracle Corporation.

Larry Ellison and his earlier colleagues, Bob Miner and Ed Oates first initiated an adviser company called Software Development Laboratories (SDL) in 1977 and developed the main

Oracle software. The name Oracle comes from the code-name of a CIA-funded project Ellison had worked on while formerly employed by Ampex.

An Oracle database system identified by an alphanumeric system identifier or SID comprises at least one instance of the application, along with data storage. An instance identified persistently by an instantiation number (or activation id: SYS.V_$DATABASE.ACTIVATION#) comprises a set of operating-system processes and memory-structures that interact with the storage. Typical processes include PMON (the process monitor) and SMON (the system monitor). Oracle documentation can refer to an active database instance as a "shared memory realm".

Users of Oracle databases refer to the server-side memory-structure as the SGA (System Global Area). The SGA typically holds cache information such as data buffers, SQL commands, and user information. In addition to storage, the database consists of online redo logs (or logs), which hold transactional history. Processes can in turn archive the online redo logs into archive logs (offline redo logs), which provide the basis for data recovery and for the physical-standby forms of data replication using Oracle Data Guard.

The Oracle RAC (Real Application Clusters) option uses multiple instances attached to a central storage array. In version 10g, grid computing introduced shared resources where an instance can use CPU resources from another node in the grid. The advantage of Oracle RAC is that the resources on both nodes are used by the database, and each node uses its own memory and CPU. Information is shared between nodes through the interconnect the virtual private network.

The Oracle DBMS can store and execute stored procedures and functions within itself. PL/SQL (Oracle Corporation's proprietary procedural extension to SQL), or the object-oriented language Java can invoke such code objects and/or provide the programming structures for writing them.

4.3 Encryption Techniques and Existing Security Mechanisms

The popularity and the use of computers and network-based electronic devices have increased rapidly. Since computers are employed in all phases of today's world, many large collections of materials, including classified confidential information that attract various illegitimate attention, are available electronically.

This research aims to develop authentication frameworks for the design and implementation of effective and efficient mechanisms for Kerberos authentication protocol used in wireless communication networks.

4.3.1 Existing security mechanisms

In this section, the existing solution techniques for Kerberos authentication protocol are analysed. Kerberos security considerations and basic operation of Kerberos in wireless communication networks are explained in detail. Additionally, solution techniques of Kerberos for wireless communication networks are elaborated. The merits and weaknesses of Kerberos and its solution techniques are critically analysed.

Since the publication of protocols by Needham and Schroeder for both the conventional or shared key algorithms and the public key algorithms (Needham and Schroeder, 1978), credible and popular spin-offs have emerged.

Kerberos authentication protocol was designed as part of the project Athena, provides secret key (symmetric key) cryptography for the authentication of client-server applications. As an authentication server, it is based in part on Needham-Schroeder Authentication Protocol (Needham and Schroeder, 1978), but with changes to support the needs of the environment for which it was developed.

It uses key distribution. Clients and servers use digital tickets to identify themselves to the network and secret cryptographic keys for secure communications (Neuman and Ts'o, 1994). Kerberos architecture is divided into two core elements, Key Distribution Centre (KDC) and Ticket Granting Service (TGS) (Kohl and Neuman, 1993),(Neuman and Ts'o, 1994).

The KDC stores authentication information while TGS holds digital tickets for identifying clients and servers of networks. The KDC acts as a trusted third party in performing these authentication services. Kerberos provides a mutual authentication between a client and a server. Mutual authentication of Kerberos uses a technique that requires a password. Many authentication techniques, (such as Wide Mouthed Frog Protocol and Splice/AS Protocol [Schneier, 1996]) send passwords as clear text (i.e. they are not secure), allowing them to be compromised by an unauthorized party.

Kerberos solves this problem via encryption. Rather than sending the password, an encrypted key derived from the password is communicated and thus the password is never sent clearly.

This technique can be used to authenticate a client and can also be used for mutual authentication of a server. Once authentication takes place, all further tra_c is also encrypted, allowing new encryption keys to be communicated securely.

Owing to the growing popularity and use of IEEE 802.11 wireless network communications, there are several different approaches for authentication and encryption of these communication networks such as Wired Equivalent Privacy (WEP) and Wi-Fi Protected Access (WPA).

These expanding approaches have ful_lled the security challenges of the technologies. Some of these include, the per-packet authentication approach described by (Mishra and Arbaugh, 2002), a_ecting access point authentication (Needham and Schroeder, 1978), and the mutual authentication based solution (Schneider, 1998), (Schneider, 1999).

Nonetheless, these approaches inadvertently rely on the notion of explicit trust on the authentication server(s). The IEEE TGi made the initial attempt by developing the Robust Security Network (RSN), which utilises the IEEE 802.1x port-based security standard to provide security services. The IEEE 802.1x standard establishes the Extensible Authentication Protocol (EAP) framework (Mishra and Arbaugh, 2002) and (Vollbrecht et al., 2001).

This EAP framework allows the use of various authentication mechanisms or approaches on top of the EAP layer (Vollbrecht et al., 2001). It uses three entities as authentication

components namely, the supplicant (client), the authenticator (access point) and the authentication server (RADIUS) (Aboba and Calhoun, 2003).

This authentication framework implies that explicit `trust' is placed on the authentication server, while the access point and wireless clients are suspects (Eneh et al., 2004). Figure 4.3 adapted from (Mishra and Arbaugh, 2002), shows the layers of the EAP protocol stack.

Nevertheless, this study reveals that current RSN architecture only supports mutual authentication between wireless clients and their corresponding access points. Where consideration is given to this scenario, the issues are based on some assumptions of the integrity of the communication channel between the access point and authentication server (Congdon et al., 2003). Therefore, the consequence is that wireless clients based on 802.11b standard and whose security provision rely on the 802.1x standard, are still liable to session hijacking and masquerading attacks on the link between authenticator and authentication server.
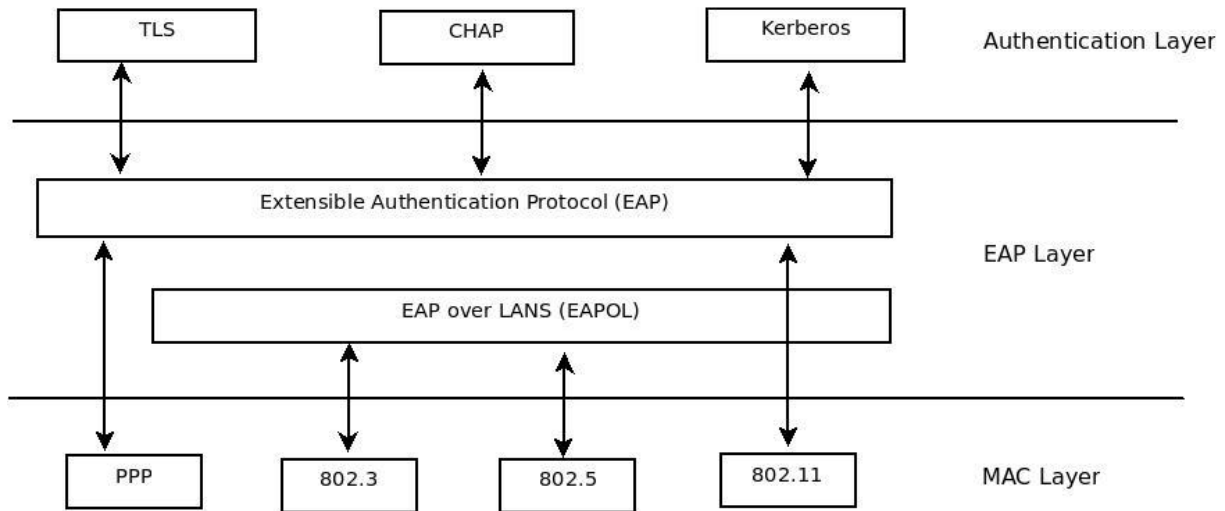

Figure 4.3: The EAP stack

Additionally, a framework, namely Tripartite Authentication Mechanism (TAM) that relies on 802.1x standard is offered (Eneh et al., 2004). The proposed framework's three entities (supplicant, authenticator, authentication server) mutually authenticate with each other prior to data tra_c. It was built on an assumption that none of the parties should be trusted in a

wireless LAN communication environment. TAM belongs to EAP authentication layer protocol. It incorporates with a user authentication module that is named as Random Selection of Sign-on Information (RoSSI) functions by making a number of challenges selected at random to the user and include facilities for re-authentication for wireless client stations whose sessions become idle for a period of time. This ensures that an attacker or a rogue wireless workstation steals no valid wireless communication session.

In wireless networks, although Kerberos relies on the provisions of IEEE 802.1x standard, owing to the fact that, its operation is system and application independent, security features for authentication are independent as well. Kerberos protocol assumes that initial transactions take place on an open network where clients and servers may not be physically secure and packets travelling on the network can be monitored and even possibly be modified (SECWP, 2007).

Due to the critical function of the KDC, multiple KDCs are normally utilised, where each KDC stores a database of users, servers, and secret keys. However, since the KDC stores secret keys for every user and server on the network; they must be kept completely secure. If an attacker were to obtain administrative access to the KDC, the attacker would have access to the complete resources of Kerberos realm.

Kerberos tickets are cached on the client systems. If an attacker gains administrative access to a Kerberos client system, he can impersonate the authenticated users of that system. In other words, the authentication service authenticates the client and replies to the client with a ticket to the TGS. The TGS receives the ticket from the client and checks its validity and replies to the client with a new ticket for the server the client wishes to use. In order to prevent ticket hijacking, Kerberos KDC must be able to verify that the user who is presenting the ticket is the same user to whom the ticket was issued [Neuman and Ts'o, 1994]. This is shown in Figure 4.4.
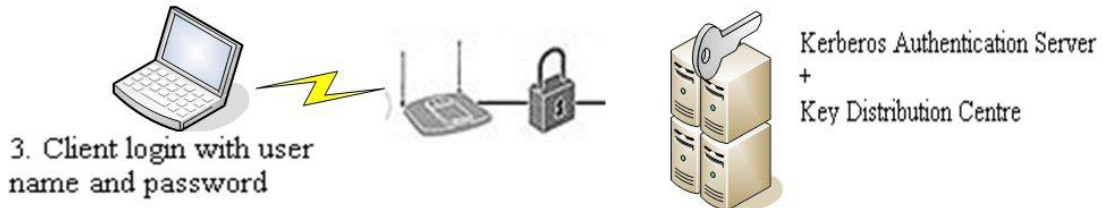
Figure 4.4: Kerberos in action in a wireless network

Firstly, they used public-key infrastructures Public Key Cryptography for Initial Authentication in Kerberos (PKINIT), Public Key Cryptography for Cross-Realm Authentication in Kerberos (PKCROSS) and Public Key Utilising Tickets for Application Servers (PKTAPP). In PKINIT, messages are added to change user secret key authentication to public key authentication. It manages secret keys for large number of clients. Nevertheless, it does not address key management of large number of realms. Additionally, as mentioned above, Kerberos uses key distribution and all tickets in its realm are issued by KDC. Since all authentications pass through the KDC, this causes performance bottleneck. At this point, PKTAPP is used for trying to eliminate bottleneck and reduce communication traffic by implementing authentication exchange directly between client and application server.

Secondly, in the same study they have proposed the use of proxy servers, Initial Authentication and Pass Through Authentication using Kerberos V5 and GSS-API (IAKERB) and Charon for mobile communication systems. Former one is used as a proxy server, when a client could not establish a direct connection with KDC. Latter one adapts standard Kerberos authentication to a mobile Personal Digital Assistant (PDA) platform. Charon uses Kerberos

to establish a trust relationship between a user and a proxy. However, as a result, it is possible to say that, although some additional public-key infrastructures are added to various stages of Kerberos, in terms of server and network capacity, they are fully suitable for simpler networks and could not work with more than one application server. In addition to these, a proxy is used to increase encryption process for both client and server; however, it produces delays during the transactions of authentication messages between client and server. Additionally, since wireless network speed increases, the proxy became insufficient and affects the response time.

Kerberos assisted authentication in mobile ad-hoc networks has been created by utilising traditional features of Kerberos (Pirzada and McDonald, 2004). Their logic appears to lack evidence that the notorious aws of traditional Kerberos have been addressed in their solution. These aws include replay attacks and distributed session keys. However, their solution seems to address issues of password guessing attacks.

4.4 High Availability, Load Balancing and Replication

Specific solutions are required for web sites that serve large numbers of requests, or provide services that demand high uptime. High-availability approaches for the LAMP stack may involve multiple web and database servers, combined with additional components that perform logical aggregation of resources provided by each of the servers, as well as distribution of the workload across multiple servers. The aggregation of web servers may be provided by placing a load balancer in front of them, for example by using Linux Virtual Server (LVS). For the aggregation of database servers, MySQL provides internal replication mechanisms, which implement a master/slave relationship between the original database (master) and its copies (slaves).

Such high-availability setups can improve the availability of LAMP instances by providing various forms of redundancy, making it possible for a certain number of an instance's components (separate servers) to experience downtime without interrupting the users of services provided by a LAMP instance. Also, such redundant setups allow for hardware failures resulting in data loss on individual servers, without the collectively stored data actually becoming lost. Beside higher availability, such LAMP setups can provide almost linear improvements in performance for services where the number of internal database read operations is much higher than the number of write/update operations.

CHAPTER 5

DISCUSSIONS AND CONCLUSION

Health is one of the largest sectors that provide employment worldwide, and no doubt has strategic importance, both for the socio-economic impact, and for the high involvement and use of advanced technologies. The type of data and process support provided by the ICT service provider depends on the type of medical application. The use of data in the context of ICT is related to the engineering of information systems for medically-related problems and applications. The increasing use of ICT tools in the digital age will provide many benefits, from advance in research to helping poor countries in achieving quality health care.

It is important that healthcare managers at every level take advantage of all the tools of technology in order to provide the highest quality service possible to citizens. At the same time, many electronic transactions carried out on the systems in each healthcare institution include a variety of data arising while providing health services. Nowadays, revealing an actual value by collecting all the information together is extremely important for the development of healthcare services. The proposed e-Healthcare Information System collects data related to health services at a center located in the Ministry of Health. The collected data is analyzed using business intelligence solutions.

The proposed e-Health Information System will provide significant benefits in terms of

- Ensuring standardization of medical-related data,
- Data analysis support and creation of decision support systems,
- Acceleration of data flow among e-healthcare stakeholders,
- Formation of electronic personal health records,
- Ensuring resource saving and improving efficiency,
- Coordinating e-healthcare initiative processes,
- Accelerating the adoption of e-healthcare concept at the national level,
- It forms a suitable infrastructure for future development like creating an inerconnection system that provide telemedicine and interconnection with cross border grids.

5.1 The Proposed E-Health Information System Provides the Following Advantages:

- **Better e-healthcare services:** Collected data form the basis of the work on the development and improvement of healthcare services.
- **Solutions open to development:** An infrastructure for the inter-institutional transfer of additional features that may be added in the future and the patient records.
- **100% integration:** The proposed e-Health Information System does not require an update of the existing hospital automation systems and integrate with them in a short time.
- **Single Centric Management:** It is ensured that the produced data is standardized, collected and recorded directly and highly detailed in the centre.
- **Open to sharing:** Information and reports may be shared according to the authority and needs. Data to be taken from decision support may be presented on the visual or digital map.

5.2 E-Healthcare Applications

The following are the most important tools proved to be cost effective in the solution of problems related to e-healthcare services,

 - Information management,

 - Improvement of the access and maintenance quality to healthcare services

-"e-Healthcare" is an umbrella term that expresses the presentation of healthcare services mainly through information and communication technologies using electronic methods and tools.

- e-Healthcare has emerged with the developments in the implementation of Health Information and Communication Technology.

5. 3 Hospital Information Management Systems

A hospital information system (HIS) is an element of health informatics that focuses mainly on the administrative needs of hospitals. In many implementations, a HIS is a comprehensive, integrated information system designed to manage all the aspects of a hospital's operation, such as medical, administrative, financial, and legal issues and the corresponding processing of services.

Hospital Information System architecture has three main levels, Central Government Level, Territory Level, and Patient Carrying Level. Generally, all types of hospital information system (HIS) are supported in client-server architectures for networking and processing. Most work positions for HIS are currently resident types. Mobile computing began with wheeled PC stands. Now tablet computers and smartphone applications are used.

Enterprise HIS with Internet architectures have been successfully deployed in Public Healthcare Territories and have been widely adopted by further entities. The Hospital Information System (HIS) is a province-wide initiative designed to improve access to patient information through a central electronic information system. HIS's goal is to streamline patient information flow and its accessibility for doctors and other health care providers. These changes in service will improve patient care quality and patient safety over time.

The patient carries system record patient information, patient laboratory test results, and patient's doctor information. Doctors can access easily person information, test results, and previous prescriptions. Patient schedule organization and early warning systems can provide by related systems.

HIS has data warehousing as the main topic, hence a more static model of information management. HIS is often composed of one or several software components with specialty-specific extensions, as well as of a large variety of sub-systems in medical specialties from a multi-vendor market. Specialized implementations name for example Laboratory Information System (LIS), Policy and Procedure Management System, Radiology Information System (RIS) or Picture archiving and communication system (PACS).

Architecture is based on a distributed approach and on the utilization of standard software products complying with the industrial and market standards must be utilized (such as: UNIX operating systems, MS-Windows, local area network based on Ethernet and TCP/IP protocols, relational database management systems based on SQL language or Oracle databases, C programming language).

Portable devices such as smartphones and table computers may be used at the bedside.

5.3.1 Healthcare information technology infrastructures in Turkey

Sağlık-Net has two main components: the National Health Information System (NHIS) and the Family Medicine Information System (FMIS). The NHIS is a nation-wide infrastructure for sharing patients' Electronic Health Records (EHRs). So far, EHRs of 78.9 million people have been created in the NHIS. Similarly, family medicine is operational in the whole country via FMIS. Centralized Hospital Appointment System enables the citizens to easily make appointments in healthcare providers. Basic Health Statistics Module is used for collecting information about the health status, risks and indicators across the country. Core Resources Management System speeds up the flow of information between the headquarters and Provincial Health Directorates. The e-prescription system is linked with Sağlık-Net and seamlessly integrated with the healthcare provider information systems. Finally, Turkey is involved in several international projects for experience sharing and disseminating national developments.(Dogac, A., et al., 2014)
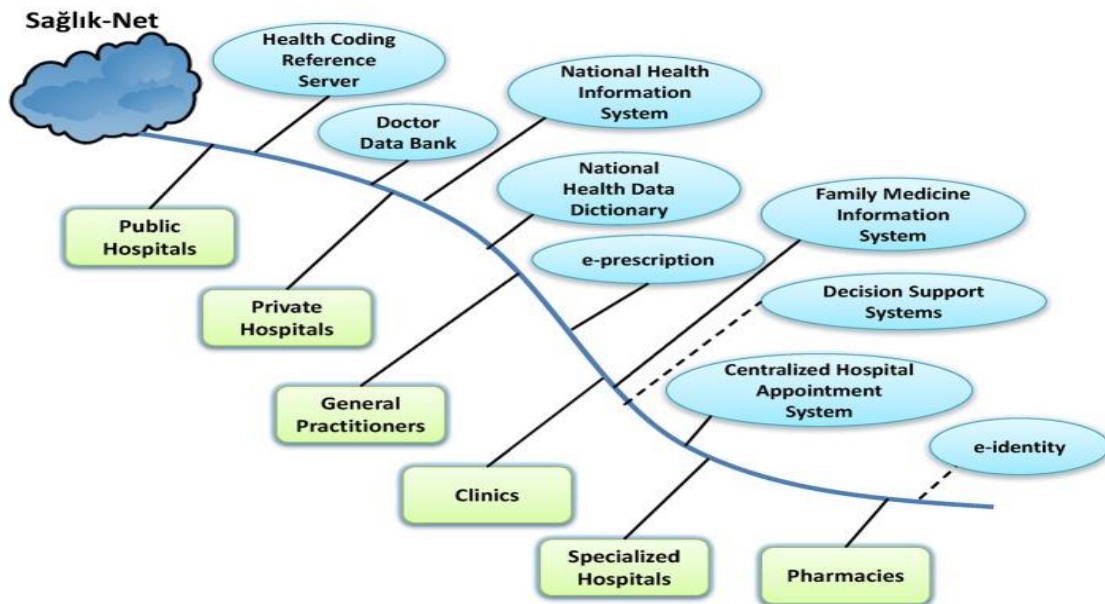

Figure 4.5: Sağlık. NET

5.4 Future Work: Concept of Telemedicine:

- European Information Society for Growth and Development (I2010) 3 Political Priority Area

1. Creation of open and competitive single market for information society and media services within the EU
2. Increasing the investment for research on information and communication technologies (ICT) by 80%
3. Promoting the European Information Society in which all the parties are involved

- Action Plan:

- Exchange of clinical and administrative data among healthcare provider and paying institutions
- Family Medicine Information System
- Hospital (Secondary Care) Management Information System
- Electronic Patient Records (EPR)

The integration of all workflows and related software components allows for comprehensive ICT solutions. Telecommunication tools used are as various and the software in telemedicine is large and is dependent on; multimedia medical database, compression of images, signal processing and transmission of data and the Internet procedures. Telemedicine is the result of convergence between telecommunication networks, medicine and health services, medical database and health information systems. In particular, telemedicine must include the exchange of medical data coming from several sources in order to support the diagnostic/ therapeutical process in medical decision making. Collaboration efforts are needed between institutions to handle large scale data collected from individuals or from existing health records and databases, to help in study progress and serve for data quality control and analysis of results. Grid technology is a software infrastructure which enables flexible, secure, coordinated resource sharing among dynamic collection of individuals and institutions. (Al-Shanableh, 2014)

The use of communication technologies in healthcare is relatively new but developing rapidly. public collaborations, collaboration between universities as well as inter-sectoral cooperation and providing interconnection with international grid shall strengthen the field of digital healthcare in TRNC. Learning the number of patients with chronic diseases as well as disabled citizens and controlling the increased healthcare needs and costs due to the gradual increase in the old population, and meeting the world standards will be possible by using e-healthcare services.

The proposed e-healthcare information system is a useful system regarding the collection and processing of relevant information on configuration and device that will minimally affect the daily life of patients and determining the necessary emergency, data processing and data transmission to central server and availability to access of the healthcare staff.

This system will become much more efficient for both patients and healthcare staff from the moment that the system starts to be implemented providing regular database by collecting the date in a safe centre as well as eliminating the information pollution among healthcare units will be secured.

REFERENCES

Aarts, J., Peel, V., and Wright, G. (1998). Organizational issues in health informatics: a model approach. *International journal of medical informatics,52(1)*, 235-242.

Baig, M. M., and Gholamhosseini, H. (2013). Smart health monitoring systems: an overview of design and modeling. *Journal of medical systems, 37(2)*, 1-14.

Bernstein, K., Bruun-Rasmussen, M., Vingtoft, S., Andersen, S. K., and Nøhr, C. (2005). Modelling and implementing electronic health records in Denmark.*International Journal of Medical Informatics, 74(2)*, 213-220.

Bielskis, A. A., Denisovas, V., Drungilas, D., Gricius, G., and Ramašauskas, O. (2015). Modelling of intelligent multi-agent based E-Health care system for people with movement disabilities. *Elektronika ir elektrotechnika, 86(6)*, 37-42.

Bitirim, Y., Tonta, Y. and Sever, H (2002). *Türkçe Arama Motorlarında Performans Değerlendirme*, Damla Matbaası

Blaya, J. A., Fraser, H. S., and Holt, B. (2010). E-health technologies show promise in developing countries. *Health Affairs, 29(2)*, 244-251.

Blumenthal, D., and Tavenner, M. (2010). The "meaningful use" regulation for electronic health records. *New England Journal of Medicine, 363(6)*, 501-504.

Bonaventure, O. (2011). Computer Networking: Principles, Protocols, and Practice. *The Saylor Foundation.*

Bouadjenek, M. R., Hacid, H., and Bouzeghoub, M. (2016). Social networks and information retrieval, how are they converging? A survey, a taxonomy and an analysis of social information retrieval approaches and platforms. *Information Systems, 56*, 1-18.

Bourne, J., and Burstein, D. (2002). DSL: *A Wiley Tech Brief (Vol. 22)*. John Wiley and Sons.

Chokhani, S., and Wallace, C. (2004). Trusted archiving. *In Proceedings of the 3rd Annual PKI RandD Workshop. NIST, (pp. 7)*.

Corey, K. E., Kartoun, U., Zheng, H., Chung, R. T., and Shaw, S. Y. (2016). Using an Electronic Medical Records Database to Identify Non-Traditional Cardiovascular Risk Factors in Nonalcoholic Fatty Liver Disease. *The American journal of gastroenterology, 111(5)*, 671-676.

Della Mea, V. (2001). What is e-health (2): the death of telemedicine?. *Journal of Medical Internet Research, 3(2)*.

Demiris, G., Afrin, L. B., Speedie, S., Courtney, K. L., Sondhi, M., Vimarlund, V., ... and Lynch, C. (2008). Patient-centered applications: use of information technology to promote disease management and wellness. A white paper by the AMIA knowledge in motion working group. *Journal of the American Medical Informatics Association, 15(1)*, 8-13.

Duncan, K. A., Austing, R. H., Katz, S., Pengov, R. E., Pogue, R. E., and Wasserman, A. I. (1978, December). Health Computing: Curriculum for an emerging profession-report of the ACM curriculum committee on health computing education. *In Proceedings of the 1978 annual conference (pp. 277-285)*. ACM.

Erdoğan, Y. (2008). Exploring the relationships among Internet usage, Internet attitudes and loneliness of Turkish adolescents. Cyberpsychology: *Journal of Psychosocial Research on Cyberspace, 2(2)*, 11-20.

Eysenbach, G., and Diepgen, T. L. (2001). The role of e-health and consumer health informatics for evidence-based patient choice in the 21st century. *Clinics in dermatology, 19(1)*, 11-17.

Farag, T., Funabiki, N., and Nakanishi, T. (2009). An access point allocation algorithm for indoor environments in wireless mesh networks. *IEICE transactions on communications, 92(3)*, 784-793.

Forster, M. E. L. (1990). Health informatics in developing countries: an analysis and two African case studies (*Doctoral dissertation, Unıversıty Of London, London School Of Economıcs (Unıted Kıngdom))*.

Gao, T., Massey, T., Selavo, L., Crawford, D., Chen, B. R., Lorincz, K., ... and Chanmugam, A. (2007). The advanced health and disaster aid network: A light-weight wireless medical system for triage. *Biomedical Circuits and Systems, IEEE Transactions on, 1(3)*, 203-216.

Goffman, W., and Newill, V. A. (1966). A methodology for test and evaluation of information retrieval systems. *Information Storage and Retrieval, 3(1)*, 19-25.

Greenes, R. A., and Shortliffe, E. H. (1990). Medical informatics: an emerging academic discipline and institutional priority. *Journal of the American Medical Association (Jama), 263(8)*, 1114-1120.

Greenes, R. A., Pappalardo, A. N., Marble, C. W., and Barnett, G. O. (1969). Design and implementation of a clinical data management system. *Computers and biomedical research, 2(5)*, 469-485.

Gunter, T. D., and Terry, N. P. (2005). The emergence of national electronic health record architectures in the United States and Australia: models, costs, and questions. *Journal of Medical Internet Research, doi:10.2196/jmir.7.1.e3*.

Habib, J. L. (2010). EHRs, meaningful use, and a model EMR. *Drug Benefit Trends, 22(4)*, 99-101.

Haessler, H. A., Holland, T., and Elshtain, E. L. (1974). Evolution of an automated database history. *Archives of internal medicine, 134(3)*, 586-591.

Health Record System. Information and insights on Health Record System. Revised on January 2016. http://healthrecordsystem.com/patients-have-concerns-regarding-privacy-issues-with-electronic-health-records/

Haux, R. (2006). Health information systems–past, present, future. *International journal of medical informatics, 75(3)*, 268-281.

Herwehe, J., Wilbright, W., Abrams, A., Bergson, S., Foxhood, J., Kaiser, M., ... and Magnus, M. (2012). Implementation of an innovative, integrated electronic medical record (EMR) and public health information exchange for HIV/AIDS. *Journal of the American Medical Informatics Association, 19(3)*, 448-452.

Homer, J. B., and Hirsch, G. B. (2006). System dynamics modeling for public health: background and opportunities. *American journal of public health, 96(3)*, 452-458.

Jha, A. K., DesRoches, C. M., Campbell, E. G., Donelan, K., Rao, S. R., Ferris, T. G., ... and Blumenthal, D. (2009). Use of electronic health records in US hospitals. *New England Journal of Medicine, 360(16)*, 1628-1638.

Kahn, M. G., Fagan, L. M., and Tu, S. (1990). Extensions to the time-oriented database model to support temporal reasoning in medical expert systems. *Methods of information in medicine, 30(1)*, 4-14.

Kenny, L. M., and Lau, L. S. (2008). Clinical teleradiology--The purpose of principles. *Medical Journal of Australia, 188(4)*, 197-198.

Krist, A. H., Woolf, S. H., Bello, G. A., Sabo, R. T., Longo, D. R., Kashiri, P., et al., (2014). Engaging primary care patients to use a patient-centered personal health record. *The Annals of Family Medicine, 12(5)*, 418-426.

Kummervold, P. E., Chronaki, C. E., Lausen, B., Prokosch, H. U., Rasmussen, J., Santana, S., et al., (2008). eHealth trends in Europe 2005-2007: a population-based survey. *Journal of medical Internet research, 10(4):e42. doi: 10.2196/jmir.1023.*.

Lawrence, S. and Giles, C.L. (1999). Accessibility of Information on the Web. *Nature 400, 11(1)*, 107-109.

Lialiou, P., Pavlopoulou, I., and Mantas, J. (2016). Health Professionals' Use of Online Information Retrieval Systems and Online Evidence. *Studies in health technology and informatics, 228*, 801.

MacKenzie, I. S., and Soukoreff, R. W. (2002). Text entry for mobile computing: Models and methods, theory and practice. *Human–Computer Interaction, 17(2-3)*, 147-198.

Maekawa, Y., and Majima, Y. (2005). Issues to be improved after introduction of a non-customized Electronic Medical Record system (EMR) in a Private General Hospital and efforts toward improvement. *Studies in health technology and informatics, 122*, 919-920.

Mandl, K. D., Markwell, D., MacDonald, R., Szolovits, P., and Kohane, I. S. (2001). Public standards and patients' control: how to keep electronic medical records accessible but privateMedical information: access and privacy. Doctrines for developing electronic medical records. Desirable characteristics of electronic medical records. Challenges and limitations for electronic medical records. ConclusionsCommentary: Open approaches to electronic patient records. Commentary: A patient's viewpoint. *British Medical Journal* (Bmj), 322(7281), 283-287.

Maron, M.E. (1984). Probabilistic Retrieval Models. *Progress in Communication Sciences, 5*, 145-176.

Mars, M., and Scott, R. E. (2010). Global e-health policy: a work in progress. *Health Affairs, 29(2),* 237-243.

Michelsen, L., Pedersen, S. S., Tilma, H. B., and Andersen, S. K. (2005). Comparing different approaches to two-level modelling of electronic health records. *Studies in health technology and informatics, 116*, 113-118.

Mitty, T. J., Shoupp, D. S., Rolfe, A. R., and Cantone, M. R. (2001*). U.S. Patent No. 6,199,052. Washington, DC: U.S. Patent and Trademark Office*.

Papadouka, V., Schaeffer, P., Metroka, A., Borthwick, A., Tehranifar, P., Leighton, J., ... and Arzt, N. (2004). Integrating the New York citywide immunization registry and the childhood blood lead registry. *Journal of Public Health Management and Practice, 10*, S72-S80.

Pecht, M., and Jaai, R. (2010). A prognostics and health management roadmap for information and electronics-rich systems. *Microelectronics Reliability, 50(3)*, 317-323.

Peterson, L. L., and Davie, B. S. (2007). Computer networks: a systems approach. Elsevier.

Pohjonen, H. (2010). Images can now cross borders, but what about the legislation. *Diagn Imaging Eur, 26(4)*.

Rensimer, E. R., Tomsovic, J. P., and Wright, P. A. (1998). *U.S. Patent No. 5,845,253. Washington, DC: U.S. Patent and Trademark Office*.

Risse, G. B., and Warner, J. H. (1992). Reconstructing clinical activities: patient records in medical history. *Social History of Medicine, 5(2)*, 183-205.

Riva, G. (2000). From Telehealth to E-health: Internet and distributed virtual reality in health care. *Cyber Psychology and Behavior, 3(6)*, 989-998.

Ruotsalainen, P., and Manning, B. (2007). A notary archive model for secure preservation and distribution of electrically signed patient documents. *International journal of medical informatics, 76(5)*, 449-453.

Salton, G. and McGill, M.J. (1983). *Introduction to Modern Information Retrieval. McGraw Hill.*

Schumaker, R. P., and Reganti, K. P. (2014). Implementation of Electronic Health Record (EHR) System in the Healthcare Industry. *International Journal of Privacy and Health Information Management (IJPHIM), 2(2)*, 57-71.

Silber, D. (2003). The case for eHealth. *European Institute of Public Administration.*

Slack, W. V., Hicks, P., Reed, C. E., and Van Cura, L. J. (1966). A computer-based medical-history system. *New England Journal of Medicine, 274(4)*, 194-198.

Stanimirović, D. (2015). Modelling the Health Information System in Slovenia–Operative, Construction and Implementation Aspects. *Information society, 13*, 15.

Świątek, P., Brzostowski, K., Drapała, J., Juszczyszyn, K., and Grzech, A. (2015). Development of intelligent ehealth systems in the future internet architecture. *In Innovative Technologies in Management and Science (pp. 73-94).* Springer International Publishing.

Tanenbaum, A. S. (2003). *Computer networks, 4-th edition.* ed: Prentice Hall.

Al-Shanableh, Tayseer, Openning Speech, *"The 2ⁿᵈ International Conference on e-Health and Telemedicine-ICEHTM 2014", 22-24 May 2014, Istanbul, Turkey, ISBN 978-9963-7393-1-8*

Terry, A. L., Thorpe, C. F., Giles, G., Brown, J. B., Harris, S. B., Reid, G. J., ... and Stewart, M. (2008). Implementing electronic health records Key factors in primary care. *Canadian Family Physician, 54(5)*, 730-736.

Thompson, D., Canada, A., Bhatt, R., Davis, J., Plesko, L., Baranowski, T., ... and Zakeri, I. (2006). eHealth recruitment challenges. *Evaluation and program planning, 29(4)*, 433-440.

Townler, H.M. (1976). *System Analysis for Information Retrieval, A Grafton Book.*

Tüttelmann, F., Luetjens, C. M., and Nieschlag, E. (2006). Optimising workflow in andrology: a new electronic patient record and database. *Asian journal of andrology, 8(2)*, 235-241.

Wangberg, S., Andreassen, H., Kummervold, P., Wynn, R., and Sørensen, T. (2009). Use of the internet for health purposes: trends in Norway 2000–2010. *Scandinavian journal of caring sciences, 23(4)*, 691-696.

Williams, S. D., and Hollinshead, W. (2004). Perspectives on Integrated Child Health Information Systems: Parents, Providers, and Public Health. *Journal of Public Health Management and Practice, 10*, S57-S60.

World Health Organization. (1988). *Informatics and telematics in health: present and potential uses. ISBN 978-9241561174*

Yasin, M., Harun, S. W., and Arof, H. (2012). *Optical fiber communications and devices*.

Yasnoff, W. A., O'Carroll, P. W., Koo, D., Linkins, R. W., and Kilbourne, E. M. (2000). Public health informatics: improving and transforming public health in the information age. *Journal of Public Health Management and Practice, 6(6)*, 67-75.

Needham and Schroeder.(1978). Key, N. S. S. *Needham Schroeder Symmetric Key*.

Kohl, J., and Neuman, C. (1993). *The Kerberos network authentication service (v5) (No. RFC 1510).*

Neuman, B. C., and Ts'o, T. (1994). Kerberos: An authentication service for computer networks. *IEEE Communications magazine, 32(9)*, 33-38.

Schneier, B. (1996). Angewandte Kryptographie. Protokolle, *Algorithmen und Sourcecode in C*.

Mishra, A., and Arbaugh, W. A. (2002). *An initial security analysis of the IEEE 802.1 X standard.*

Aboba, B., and Calhoun, P. R. (2003). *RADIUS (remote authentication dial in user service) support for extensible authentication protocol (EAP).*

Nwaneka, C. V., and Eneh, A. U. (2004). Malaria parasitaemia in neonates in Port Harcourt, Nigeria. *Journal of tropical pediatrics, 50(2)*, 114-116.

FLOWCHART of E-HEALTH NETWORK
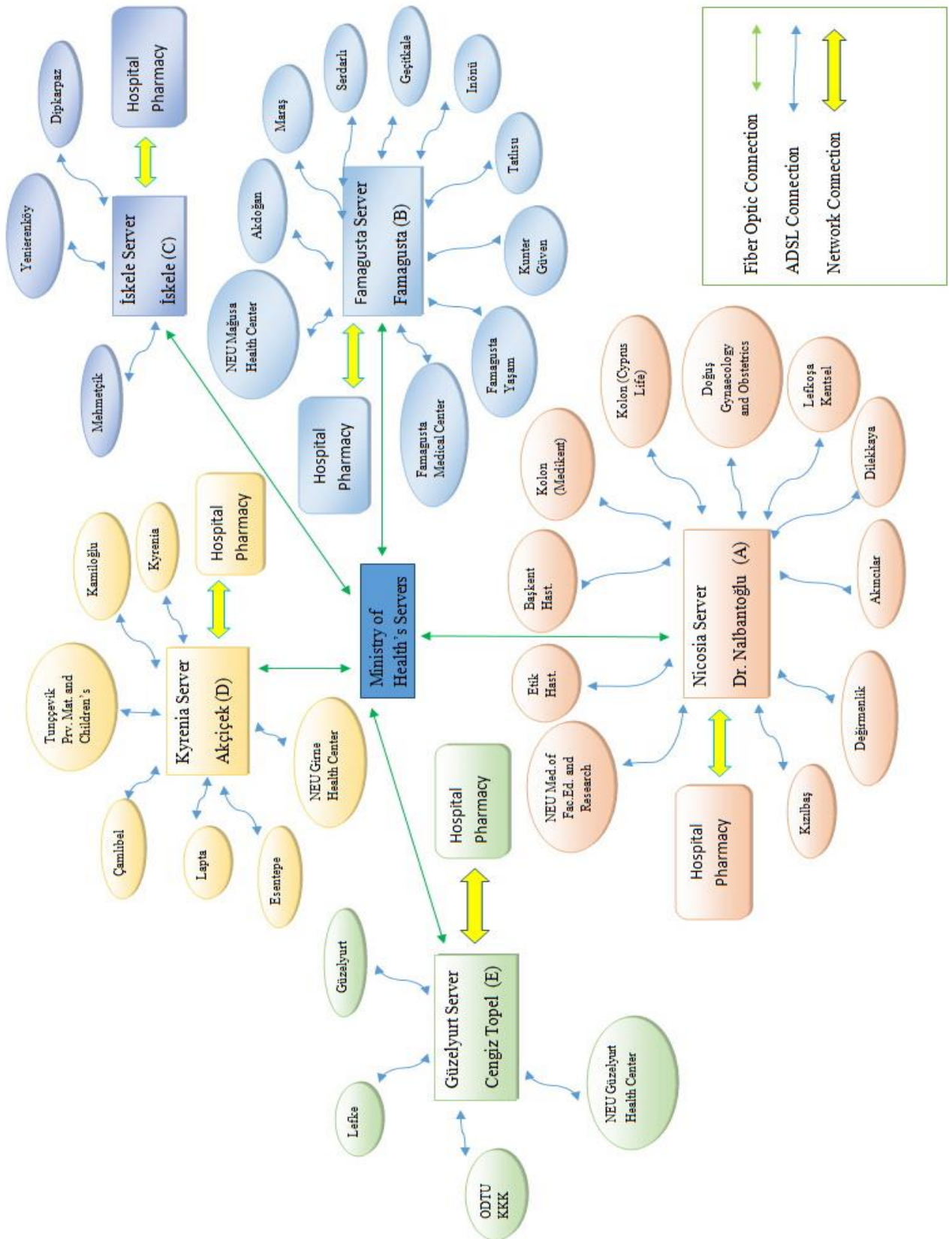
APPENDIX B

HOSPITALS AND HEALTH CARE CENTERS IN NORTH CYPRUS

Hospitals	State H.	Private H.	Health Center	Bed Capacity	Care	Place
Dr. Burhan Nalbantoğlu (A)	x			379	III.	Nicosia
Famagusta (B)	x			120	II.	Famagusta
Akçiçek (D)	x			56	II.	Kyrenia
Cengiz Topel (E)	x			45	II.	Güzelyurt
Barış Psychiatric (A)	x			180	-	Nicosia
Chronic Diseases (Elderly Care) (A)	x			45	-	Nicosia
Thalassaemia (Dr. B. Nalbantoğlu) (A)	x			12	-	Nicosia
Radiation Onc. (Dr. B. Nalbantoğlu) (A)	x			12	-	Nicosia
NEU Med.of Fac.Ed. and Research (1)		x		500		Nicosia
Etik (2)		x		16		Nicosia
Kyrenia (24)		x		14		Kyrenia
Başkent (3)		x		14		Nicosia
Famagusta Medical Center (12)		x		25		Famagusta
Kamiloğlu (25)		x		10		Kyrenia
Kolon (Previosly Medikent) (4)		x		50		Nicosia
Kolon (Previously Cyprus Life) (5)		x		20		Nicosia
Famagusta Yaşam (13)		x		20		Famagusta
Tunççevik Prv. Mat. and Children's (26)		x		6		Kyrenia
Kunter Güven (14)		x		10		Famagusta
Doğuş Gynaecology and Obstetrics (6)		x		11		Nicosia
Lefkoşa Kentsel (7)			x			Nicosia
Akdoğan (20)			x			Famagusta
Güzelyurt (30)			x			Güzelyurt
Maraş (19)			x			Famagusta
Mehmetçik (23)			x			İskele
İskele (C)			x			İskele
Serdarlı (18)			x			Famagusta
Yenierenköy (22)			x			İskele

Geçitkale (17)	x	Famagusta
Dipkarpaz (21)	x	İskele
İnönü (16)	x	Famagusta
Değirmenlik (10)	x	Nicosia
Esentepe (29)	x	Kyrenia
Lapta (28)	x	Kyrenia
Tatlısu (15)	x	Famagusta
Akıncılar (9)	x	Nicosia
Çamlıbel (27)	x	Kyrenia
Kızılbaş (11)	x	Nicosia
Lefke (31)	x	Güzelyurt
Dilekkaya (8)	x	Nicosia
ODTÜ KKK (32)	x	Güzelyurt
NEU Güzelyurt Health Center (33)	x	Güzelyurt
NEU Girne Health Center (34)	x	Kyrenia
NEU Mağusa Health Center (35)	x	Famagusta

NATIONAL HEALTH SYSTEM and SOURCE CODE

```html
<script charset="windows-1254" src="/Content/js/plugin/jQuery/jquery-2.1.1.min.js"></script>

<script src="/Content/js/plugin/jquery-cookie/jquery.cookie.js"></script>

<script src="/Content/js/plugin/jQuery/jquery.unobtrusive-ajax.min.js"></script>

<script src="/Content/js/plugin/jQuery/jquery-ui-1.10.3.min.js"></script>

<script src="/Content/js/plugin/theme-default/mvchelper.min.js?v=11:59"></script>

<!-- IMPORTANT: APP CONFIG -->

<script src="/Content/js/plugin/theme-default/smartadmin.app.config.js"></script>

<!-- JS TOUCH : include this plugin for mobile drag / drop touch events-->

<script src="/Content/js/plugin/jquery-touch/jquery.ui.touch-punch.min.js"></script>

<!-- BOOTSTRAP JS -->

<script src="/Content/js/Plugin/bootstrap/bootstrap.min.js"></script>

<!-- CUSTOM NOTIFICATION -->

<script src="/Content/js/plugin/notification/SmartNotification.min.js"></script>

<!-- JARVIS WIDGETS -->

<script src="/Content/js/plugin/smartwidgets/jarvis.widget.min.js"></script>

<!-- EASY PIE CHARTS -->

<script src="/Content/js/plugin/easy-pie-chart/jquery.easy-pie-chart.min.js"></script>

<!-- SPARKLINES -->

<script src="/Content/js/plugin/sparkline/jquery.sparkline.min.js"></script>

<!-- JQUERY VALIDATE -->

<script src="/Content/js/plugin/jquery-validate/jquery.validate.min.js"></script>

<script src="/Content/js/plugin/jquery-validate/jquery.validate.unobtrusive.min.js"></script>
```

<!-- JQUERY MASKED INPUT -->

<script src="/Content/js/plugin/masked-input/jquery.maskedinput.min.js"></script>

<!-- JQUERY SELECT2 INPUT -->

<script src="/Content/js/plugin/select2/select2.min.js"></script>

<!-- JQUERY UI + Bootstrap Slider -->

<script src="/Content/js/plugin/bootstrap-slider/bootstrap-slider.min.js"></script>

<!-- browser msie issue fix -->

<script src="/Content/js/plugin/msie-fix/jquery.mb.browser.min.js"></script>

<!-- FastClick: For mobile devices -->

<script src="/Content/js/plugin/fastclick/fastclick.min.js"></script>

<!-- Chosen Multiselect -->

<script src="/Content/js/plugin/chosen/chosen.jquery.min.js"></script>

<!-- Summernote Editor -->

<script src="/Content/js/plugin/summernote/summernote.min.js"></script>

<!--[if IE 8]>

<h1>Your browser is out of date, please update your browser by going to www.microsoft.com/download

</h1>

<![endif]-->

<!-- MAIN APP JS FILE -->

<script charset="windows-1254" src="/Content/js/plugin/theme-default/smartadmin.app.min.js">

</script>

<script src="/Content/js/hsys/hsys.app.js?v=11:59"></script>

<!-- Morris Chart Dependencies -->

```html
<script src="/Content/js/plugin/morris/raphael.min.js"></script>

<script src="/Content/js/plugin/morris/morris.min.js"></script>

<script src="/Content/js/plugin/chartjs/chart.min.js"></script>

<!-- Vector Maps Plugin: Vectormap engine, Vectormap language -->
<script charset="windows-1254" src="/Content/js/plugin/vectormap/jquery-jvectormap-1.2.2.min.js">
</script>

<script charset="windows-1254" src="/Content/js/plugin/vectormap/jquery-jvectormap-world-mill-en.js">
</script>

<!-- Full Calendar -->
<script charset="windows-1254" src="/Content/js/plugin/moment/moment.min.js"></script>

<script charset="windows-1254" src="/Content/js/plugin/fullcalendar/jquery.fullcalendar.min.js">
</script>

<script charset="windows-1254" src="/Content/js/plugin/fullcalendar/jquery.fullcalendar.lang.min.js">
</script>

<!-- PAGE RELATED PLUGIN(S) -->
<script src="/Content/js/plugin/datatables/jquery.dataTables.min.js"></script>

<script src="/Content/js/plugin/datatables/dataTables.colVis.min.js"></script>

<script src="/Content/js/plugin/datatables/dataTables.tableTools.min.js"></script>

<script src="/Content/js/plugin/datatables/dataTables.bootstrap.min.js"></script>

<script src="/Content/js/plugin/datatable-responsive/datatables.responsive.min.js"></script>

<script src="/Content/js/plugin/bootstrapvalidator/bootstrapValidator.min.js"></script>

<script src="/Content/js/plugin/bootstrap-progressbar/bootstrap-progressbar.min.js"></script>

<script src="/Content/js/plugin/masked-input/jquery.maskedinput.min.js"></script>
```

```
<script src="/Content/js/plugin/jQuery-Datetimepicker/jquery.datetimepicker.full.min.js"></script>

<script src="/Content/js/hsys/hsys.pagehelper.js?v=11:59"></script>

<script src="/Content/js/hsys/hsys.enums.js?v=11:59"></script>

<script src="/Content/js/hsys/hsys.helpers.js?v=11:59"></script>

<script src="/Content/js/plugin/dropzone/dropzone.min.js"></script>

<script>

$(document).ready(function () {

// DO NOT REMOVE : GLOBAL FUNCTIONS!

var StartprocessQueue;

pageSetUp();

moment.locale('tr');

});

// GLOBAL CONTEXT

</script>

<link href="/Content/css/smartadmin-production-plugins.min.css" rel="stylesheet" />

<link href="/Content/css/smartadmin-production.min.css" rel="stylesheet" />

<script src="/Content/e-imza/scripts/pwsigner.min.js?v=11:59"></script>

<script src="/Content/e-imza/eimza.js?v=11:59"></script>

<link rel="shortcut icon" href="/Content/img/login/sb_icon.png" type="image/x-icon" />

<link href="/Content/css/login/reset.css" rel="stylesheet" />

<link href="/Content/css/login/giris.css" rel="stylesheet" />

<link href="/Content/css/login/bootstrap.min.css" rel="stylesheet" />

<link href="/Content/css/login/Harabara_TR.css" rel="stylesheet" type="text/css" charset="utf-8" />
```

```html
<link href="/Content/css/mbys.css" rel="stylesheet" />

<div class="modal fade" id="modalBildirim" role="dialog">

<div class="modal-dialog modal-lg">

<div class="modal-content">

<div class="modal-header">

<button type="button" class="close" data-dismiss="modal" onclick="HideModal()">andtimes;</button>

<h3 class="modal-title" id="modalBildirimTitle"></h3>

</div>

<div class="modal-body" id="modalBildirimContent">

</div>

</div>

</div>

</div>

<div class="modal fade" id="modalBildirim-m" role="dialog">

<div class="modal-dialog">

<div class="modal-content">

<div class="modal-header">

<button type="button" class="close" data-dismiss="modal" onclick="HideModal()">andtimes;</button>

<h3 class="modal-title" id="modalBildirimTitle-m"></h3>

</div>

<div class="modal-body" id="modalBildirimContent-m">

</div>

</div>
```

```html
</div>

</div>

<div class="container">

<div class="info">

<img src="/Content/img/login/hs_logo.svg" alt="" class="logo" />

</div>

</div>

<div class="form formLogin">

<form class="register-form">

<p class="message">

* Eğer kullanıcı adınızdan ve şifrenizden eminseniz ve giriş yapamıyorsanız yöneticinizle irtibata geçin.

</p>

</form>

<form class="form-horizontal" id="git">

<div class="form-horizontal" id="frmEimza">

<h2 style="text-align: center;" class="kucuk">E-imza ile Giriş</h2>

<p id="geri" class="message">andlt;andlt; Giriş Sayfasına <a id="dvShowGiris" href="#">Geri Dön</a>

</p>

<br />

<div class="row">

<div class="col-sm-12 col-md-12 col-lg-12">

<div class="form-group">

<label for="last_name">Kart Tipi </label>

<select id="cmbCardType"
```

class="form-control"

style="width: 200px;display:inline !important; margin-bottom: 10px;margin-left: 4px;"></select>

<img onclick="listTerminals()"

src="/Content/e-imza/img/refresh.png"

alt="Yenile" style="width:20px;cursor: pointer;" width="20" height="20">

</div>

</div>

</div>

<div class="row">

<div class="col-sm-12 col-md-12 col-lg-12">

<div class="form-group">

<label>Sertifika </label>

<select id="cmbCertificate"

style="display:inline !important;width: 200px;margin-bottom: 10px;margin-left: 6px;"

class="form-control"></select>

</div>

</div>

</div>

<div class="row">

<div class="col-sm-12 col-md-12 col-lg-12">

<div class="form-group">

<label>Pin Kodu</label>

<input type="password"

```
style="display:inline !important;width: 200px;margin-bottom: 10px;" class="form-control"

id="numpad" role="textbox">

</div>

</div>

</div>

<br />

<div class="form-group">

<div class="col-sm-12">

<button type="button" onclick="signContract()" class="btn btn-primary">Giriş</button>

</div>

</div>

<p class="message" id="indirmelinki">

* <a href="/Content/e-imza/ArkSigner-Installer-StandardUser-v1.5.3.exe">

E-İmza Uygulaması Bulunamamıştır. İndirmek için tıklayınız.</a></p>

<p class="message">

* Eğer kullanıcı adınızdan ve şifrenizden eminseniz ve giriş yapamıyorsanız yöneticinizle irtibata geçin.

</p>

<p class="message">


* Sisteme giriş ve karşılaştığınız problemlerle ilgili <a href="https://yazilimdestek.saglik.gov.tr/">

YAZILIM DESTEK</a>'ten veya 0312 248 51 51 nolu telefondan bize ulaşabilirsiniz...

</p>

</div>

<div id="dvLogin">
```

```html
<div class="list-group col-md-12 col-sm-12 col-xs-12 projeler">

<div class="col-md-4" style="padding-left: 0px;">

<img src="/Content/img/login/cark.svg" alt="" style="float: left; width: 90px;" />

</div>

<div class="col-md-8">

<h1 class="kucuk" style="font-family: serif !important;">Halk Sağlığı Yand#246;netim Sistemi</h1>

<h4 class="buyuk">Giriş</h4>

</div>

</div>

<form action="/Account/Login" class="form-horizontal" data-ajax="true"

data-ajax-begin="AjaxFormOnBegin" data-ajax-complete="AjaxFormOnComplete"

data-ajax-method="Post" data-enablecache="false" id="frmLogin" method="post">

<input data-val="true" data-val-number="The field ModuleId must be a number."

id="ModuleId" name="ModuleId" type="hidden" value="" />

<input id="ReturnUrl" name="ReturnUrl" type="hidden" value="http://hsys.saglik.gov.tr:8080/" />

<div class="form-group">

<div class="col-sm-12">

<input class="input-validation-error form-control" data-val="true"

data-val-required="Kullanıcı adı boş bırakılamaz"

id="UserName" name="UserName" placeholder="E-posta / TC Kimlik No" type="text" value="" />

</div>

</div>

<div class="form-group">

<div class="col-sm-12">
```

```html
<input class="input-validation-error form-control" data-val="true"

data-val-required="Şifre boş bırakılamaz"

id="Password" name="Password" placeholder="Şifre..." type="password" />

</div>

</div>

<div class="form-group">

<div>

<div class="checkbox col-md-6 col-xs-6">

<div>

<input type="checkbox" name="RememberMe" id="RememberMe" value="value">

<label for="RememberMe" class="beni_hatirla">Beni hatırla</label>

</div>

</div>

<div class="checkbox col-md-6 col-xs-6">

</div>

</div>

</div>

<div class="form-group">

<div class="col-sm-12">

<button id="btnLogin" type="submit" class="btn btn-primary">GİRİŞ</button>

</div>

<div class="col-sm-12" align="right">

V 1.1.004

</div>
```

```html
</div>

</form>

<p class="message" id="eImzaGiris">

* <a onclick="initializeSigner()" href="#"> E-imza ile giriş</a>

</p>

<p class="message">

* Eğer kullanıcı adınızdan ve şifrenizden eminseniz ve giriş yapamıyorsanız yöneticinizle irtibata geçin.

</p>

<p class="message">

* Sisteme giriş ve karşılaştığınız problemlerle ilgili <a href="https://yazilimdestek.saglik.gov.tr/">

YAZILIM DESTEK</a>'ten veya 0312 248 51 51 nolu telefondan bize ulaşabilirsiniz...

</p>

</div>

</form>

</div>

<div id="BackGroundFreezer" class="BackGroundFreezer"></div>

<div id="BackGroundFreezerPreloader" class="BackGroundFreezer" align="center">

<div class="loader">

<div class="cssload-inner cssload-one"></div>

<div class="cssload-inner cssload-two"></div>

<div class="cssload-inner cssload-three"></div>

</div>

</div>

<script>
```

```
$(function () {

$("#btnLogin").on("click", function (e) {

debugger;

if (isEmptyOrSpaces($('#UserName').val()) || isEmptyOrSpaces($('#Password').val())) {

e.preventDefault();

ShowMessage(2, "Lütfen E-posta / TC Kimlik No ve Şifre alanlarını doldurunuz.");

return false;

}

ShowLoader();

if ($("#RememberMe").is(":checked")) {

localStorage.UserUsername = $("#UserName").val();

localStorage.UserPassword = $("#Password").val();

localStorage.RememberMe = true;

}

else if (!$("#RememberMe").is(":checked")) {

localStorage.UserUsername = null;

localStorage.UserPassword = null;

localStorage.RememberMe = null;

}

});

if (localStorage.RememberMe != "null" andand localStorage.RememberMe == "true") {

if (localStorage.UserUsername != "null" andand localStorage.UserUsername != undefined) {

$("#UserName").val(localStorage.UserUsername);

}
```

```
if (localStorage.UserPassword != "null" andand localStorage.UserPassword != undefined) {

$("#Password").val(localStorage.UserPassword);

}

if (localStorage.RememberMe != "null" andand localStorage.RememberMe != undefined) {

$("#RememberMe").prop('checked', true);

}

}

});

$("input").keydown(function (event) {

debugger;

if (event.keyCode == 13) {

event.preventDefault();

if (isEmptyOrSpaces($('#UserName').val()) || isEmptyOrSpaces($('#Password').val())) {

ShowMessage(2, "Lütfen E-posta / TC Kimlik No ve Şifre alanlarını doldurunuz.");

return false;

}

$("form").submit();

return false;

}

});

$(document).ready(new function () {

$('.message a').click(function () {

$('#frmEimza').show();
```

```
$('#dvLogin').hide();

});

$("#dvShowGiris").click(function (e) {

e.preventDefault();//this will prevent the link trying to navigate to another page

$('#frmEimza').hide();

$('#dvLogin').show();

});

$('#frmEimza').hide();

//$('#dvLogin').hide();

});

function isEmptyOrSpaces(str) {

return str === null || str.match(/^ *$/) !== null;

}

function btnTakipsizGebelikClick() {

window.location.href = '/TakipsizGebelik';

}

function btnHsysLoginClick() {

$('#dvLogin').show();

$('#divSecim').hide();

}


</script>
```