# AN INVESTIGATION ON THE USE OF PATIENT FOLLOW-UP SOFTWARE BY PEDIATRICIANS IN İZMİR METROPOLITAN AREA

147015

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A THESIS SUBMITTED TO
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## ABSTRACT

AN INVESTIGATION ON THE USE OF PATIENT FOLLOW-UP SOFTWARE BY PEDIATRICIANS IN İZMİR METROPOLITAN AREA

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This thesis analyzes the use of pediatric patient follow-up software by the pediatricians in İzmir metropolitan area and these professionals' willingness to adopt the proposed web-based model. Implementations of electronic patient medical record keeping (EMR) systems in office-based settings are rapidly increasing. Within the developing market for EMR systems, the objectives of the study are to: 1) investigate significant aspects of pediatric EMR use on a selected group of pediatricians in İzmir metropolitan area, 2) develop a web-based pediatric EMR model to be proposed for adoption in private practice settings, and 3) assess the level of willingness in adopting the proposed web-based model among the selected sample of pediatricians.



Keywords: Pediatric Follow-up Software, Electronic Patient Medical Record Keeping Systems, EMR, Web-based EMR Model, İzmir Metropolitan Case Study, MIS Application in Healthcare Sector.

# ÖZET


İZMİR METROPOLÜNDEKİ ÖZEL ÇOCUK HEKİMLERİNİN ELEKTRONİK HASTA TAKİP PROGRAMI KULLANIMINA İLİŞKİN BİR ARAŞTIRMA

Emek Barış KÖPRÜBAŞI

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Bu çalışma, İzmir metropolündeki özel çocuk hekimlerinin elektronik hasta takip programı kullanımını ve bu hekimlerin teklif edilen web-tabanlı hasta takip programı modelini benimsemeye istekli olup olmadıklarını incelemektedir. Özel olarak hizmet vermekte olan muayenehane ortamlarında elektornik hasta kayıt sistemleri uygulamaları hızlı bir şekilde artmaktadır. Gelişmekte olan EMR sistemleri piyasasında, bu çalışmanın amaçları şunlardır: 1) İzmir metropolünde seçilmiş olan çocuk hekimleri grubu üzerinde pediyatrik EMR sistemi kullanımının anlamlı ve önemli olan yönlerini incelemek, 2) özel muayenehanesi bulunan çocuk doktorlarının kullanımına yönelik web-tabanlı pediyatrik EMR sisteminin geliştirilmesi ve benimsenmesine yönelik teklif verilmesi, ve 3) çocuk doktorları örneklemi üzerinde, teklif edilen web-tabanlı modelinin ne düzeyde benimsenebileceğinin araştırılması.



Anahtar Kelimeler: Pediyatrik Hasta Takip Yazılımı, Elektronik Hasta Tıbbi Kayıt Tutma Sistemleri, EHTP, Web-tabanlı EHTP Modeli, İzmir Metropolü Örnek Olay Çalışması, Sağlık Sektöründe YBS Uygulaması.

To My Wife and My Parents

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and all of the other pediatricians who were voluntarily involved in the study.

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# GLOSSARY

**AAP-** American Academy of Pediatrics

**ASP-** Active Server Pages are HTML pages that contain embedded scripts. IIS (Internet Information Server) and third party providers offer server software that interprets Active Server code. ASP pages contain either server side or client side scripts which performs functions such as database access, page personalization, or interactive functions. Scripts act similar to CGI scripts. Pages should end in .asp.

**Client server-** Also known as a "file server" or "server." A computer (in a network) dedicated to all of the processing and storing of files. Computers connected to the file server can have access to all programs and files located on the server.

**Computerized Tomography (CT)-** Also called computerized axial tomography (CAT); a scanning method that uses computerized x-ray images to provide a three-dimensional picture of an internal part of the body.

**Downloading-** When a computer receives information from the Internet. (See "Uploading.")

**E-mail-** Electronic mail that is sent from one computer to another.

**EEG-** An electroencephalogram (EEG) is a test to detect abnormalities in the electrical activity of the brain. EEG is used to help diagnose the presence and type of seizure disorders, to look for causes of confusion, and to evaluate head injuries, tumors, infections, degenerative diseases, and metabolic disturbances that affect the brain.

**EMR (CPR)-** EMR stands for electronic medical record. Electronic medical records are confidential computer based records that is kept for each patient by a healthcare professional or organization. It contains the patient's personal details (such as name, address, date of birth), a summary of the patient's medical history, and documentation of each event, including symptoms, diagnosis, treatment and outcome. Relevant documents such as laboratory test results, MR, CT and X-ray results are also included. In this text, EMR is used synonymously with the term computer-based patient follow-up record.

**Entity-Relationship Diagram-** An entity-relationship diagram is a specialized graphic that illustrates the interrelationships between entities in a database.

**Flowchart Diagram-** A graphical representation in which symbols are used to represent such things as operations, data, flow direction, and equipment, for the definition, analysis, or solution of a problem.

**FTP-** File Transfer Protocol. An application for transferring information between computers or to and from the Internet.

**GSM-** Global System for Mobile communications. This is a digital mobile phone system that is the standard in Europe and Asia, and it is currently more widely used than CDMA and TDMA. GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It is based on TDMA, and it utilizes the 900Mhz and 1800 Mhz bands.

**Internet-** An interconnected system of computer networks, not unlike the international telephone system.

**ISDN-** The term stands for Integrated Services Digital Network, is a system of digital phone connections which has been available for over a decade. This system allows voice and data to be transmitted simultaneously across the world using end-to-end digital connectivity. ISDN Internet service generally supports data rates of 128 Kbps. ISDN emerged as an alternative to traditional dial-up networking during the 1990s. The relatively high cost of service, though, limited its popularity with home users. The much higher speeds supports by newer cable and DSL technologies diminish the importance of ISDN for home networking, but ISDN technology may still have application in other areas of business.

**ISP-** A company which provides other companies or individuals with access to, or presence on, the Internet. Most ISPs are also Internet Access Providers; extra services include help with design, creation and administration of World-Wide Web sites, training, and administration of intranets.

**Java Applet-** small application-program component that typically executes in a client's web browser, but can execute in a variety of other simple applications or devices; Java applets support the applet programming model and may be downloaded through the Internet via a Web site and run directly on a remote computer; Java applets are often used to create Web page effects.

**Javascript-** A programming language which allows small applications to run on computers regardless of their platform (i.e. Windows, Macintosh). These small applications are sometimes referred to as "scripts" or "Applets." JavaScript is a client-side technology, meaning the computations requested by the scripts are performed by the user's local computer rather than by a

server located at a distance.

**Links-** A code that allows a user to go from one Web site to another or to different sections within the same Web site. Also known as "hypertext links" or "hot links." Links appear on a Web site in a special color and are underlined. The user simply clicks on the underlined text to move to the new location.

**Listserv-** An electronic mailing list, usually topically-oriented, that subscribers receive via e-mail. An example of a listserv is Fam-Med, which addresses the topic of computer use in family practice.

**MIS-** An organized assembly of resources and procedures required to collect, process, and distribute data for use in decision making.

**MR-** Magnetic resonance imaging of coronary artery anomalies.

**Operating system-** Provides the basic structure and commands that operate the computer. The most commonly known operating systems are Windows, Macintosh, DOS and MS-DOS. Operating systems are also referred to as "platforms".

**Pediatric Patient Follow-up Software-** It is a software designed for keeping patient's medical records. The term is used synonymously with electronic medical record keeping (EMR) software within the text.

**Prototyping-** Prototyping is a technique for building a quick and rough version of a desired system or parts of that system. The prototype illustrates the capabilities of the system to users and designers. It serves as a communications mechanism to allow reviewers to understand interactions with the system.

**SMS-** Short Message Service (SMS) is the transmission of short text messages to and from a mobile phone, fax machine and/or IP address. Messages must be no longer than 160 alpha-numeric characters and contain no images or graphics.

**Storyboard-** A storyboard is a set of drawings depicting a set of user activities that occur in an existing or envisioned system or capability. Customers, users, or developers start by drawing pictures of the screens, dialogs, toolbars, and other elements they believe the software should provide.

**Type A Pediatrician-** A pediatrician who makes use of a pediatric EMR software for his/her private practice.

**Type B Pediatrician-** A pediatrician who does not make use of a pediatric EMR software for his/her private practice.

**Type I Error-** The error made in the statistical testing of a hypothesis by rejecting the null hypothesis when it is actually true.

**Type II Error-** In the case of a Type II error, a false null hypothesis is failed to be rejected. A Type II error is only an error in the sense that an opportunity to reject the null hypothesis correctly was lost. It is not an error in the sense that an incorrect conclusion was drawn since no conclusion is drawn when the null hypothesis is not rejected.

**Uploading-** When a computer sends information to the Internet. (See "Downloading.")

**URL-** Uniform Resource Locator. A web site address, such as http://www.doctorx.info.

**Virus-** A program that can disrupt or destroy a computer's operations. Software can be installed that will alert the user to a potential exposure to a virus. Common means of virus transmission are through downloading files from the Internet or sharing floppy diskettes.

**WAN-** Wide Area Network. A network that links computers together from multiple distant sites.

**Web browser-** A program that gives access to and allows the user to search for information on the World Wide Web. A user needs a Web browser in order to use a "search engine." Common Web browsers are Netscape Navigator and Microsoft Internet Explorer. (See "Search engine.")

**Web Portal-** Commonly referred to as simply a *portal*, a Web site or service that offers a broad array of resources and services, such as e-mail, forums, search engines, and on-line shopping malls. The first Web portals were online services, such as AOL, that provided access to the Web, but by now most of the traditional search engines have transformed themselves into Web portals to attract and keep a larger audience.

**Web site-** A group of Web pages located on the World Wide Web that are developed and maintained by an organization, university, government entity, commercial enterprise, individual, etc. (http://www. doctorx.info).

**World Wide Web-** A component of the Internet where a user can access text, graphics, etc. This term is often used interchangeably with Internet. (See "Internet.")

**X-ray-** A radiogram made by exposing photographic film to X rays; used in medical diagnosis

*"Every primary care provider will use information technology that includes electronic health records with the ability to access and communicate needed clinical information to achieve high quality, safe, and affordable health care."*

Vision Statement of The National Alliance for Primary Care Informatics (NAPCI), November 2000 Summit

*Chapter 1*

# INTRODUCTION

## 1.1 Purpose and Methodology of The Investigation

### 1.1.1. Purpose

Communication is a basic link in the patient doctor relationship. Successful communication of information improves the patients understanding of the diagnosis and increases adherence to therapeutic recommendations and interventions (Verma 884-888). The ways and means of communication of information have changed with time. From the traditional face to face talk we have now advanced to computer aided communication via Internet, the "Information Highway"(IH). It is estimated that the number of internet user worldwide will grow to 350 million by the year 2003. Gross estimates also indicate that a quarter of the data on the internet is health related and about one third of surfers are searching for this information. A large percentage of such users are medical professionals, who utilize internet not only for quick access of medical information, but also to communicate and advise their patients, sitting in their home/clinic/chamber at click of mouse. Verma suggests that the proliferation of electronic data within the modern health information infrastructure presents significant benefits to health care providers and patients, including enhanced patient autonomy, improved clinical treatment based on advances in health research, public health surveillance and modern security

techniques (885). Views like Verma's and the growing popularity of internet use world-wide can be considered as the triggering factors behind the proposal of a pediatric web-based patient follow-up software which will form the subject matter of this paper.

The primary purpose of this study is to develop a web-based EMR model and to find out whether the proportion of those pediatricians who would be willing to make use of the proposed web-based model is equal to 50% of or greater than the entire population. Secondary issues include an assessment of the survey results on EMR use and to find out if there is an association between EMR use and willingness to adopt the proposed web-based model. An investigational study is conducted to find out about the pediatricians' use of electronic patient follow-up software in İzmir metropolitan area and their perceptions on willingness to adopt the proposed web-based model.

A web-based patient follow-up (Electronic Medical Record Keeping) software is designed for investigating if it can be put in practice by pediatricians who have their own private offices. The web-based model serves three different parties; pediatricians, their patients, and the laboratories that the pediatricians work with. Pediatrician's part of the software includes six different modules; a module for storing patient's personal data, a module for storing patient's immunization calendar, a module for storing laboratory test results, a module for database file transfer, a module for storing appointments, and a module for online chat with the patients. This part also includes links to favorite GSM operators' websites for internet to mobile phone messaging. Patient's zone involves a module for patient data retrieval, a module for sending MR, computerized

tomography (CT), X-ray and EEG results through the internet, a module for viewing doctor's appointments, and a module for online chat with the doctor. Laboratory's zone consists of submission forms for sending laboratory test results. Additionally, the software involves a topic center in which patient parents and outsiders can find useful information related to child care and diseases. There are links to frequently asked questions on child/infant care, doctor's contact information, multimedia archives, and a monthly newsletter.

### 1.1.2. Methodology

The study is conducted on a selected sample of pediatricians in İzmir metropolitan area who practice privately. All of the pediatricians involved in the study are members of İzmir Medical Chamber and are either working on their own and/or affiliates of public or private health care institutions. They all have earned their M.D. degrees at least in the field of pediatrics and its related sciences and have met all of the requirements needed to receive their titles. The aim of the study is to find out whether these pediatricians make use of electronic medical record keeping software in their practices, to what extent they make use of these software, proposal of a web-based model and to question whether the proportion of those pediatricians who would be willing to adopt the proposed web-based model is equal to or greater than 50% of the entire population. A second assumption on, whether the proportion of those pediatricians who previously had an experience with some type of a patient follow-up software and would be willing to make use of the proposed web-based model is the same as or greater than those pediatricians who previously had no experience with some type of a patient follow-up software and would still be willing to make use of the proposed

web-based model, is also tested. The study focuses on the management (administrative) dimension of using such systems. In particular, the emphasis is on the statistical findings of the research and the development of the web-based model. The paper discusses the relationship between statistical findings and unconventional management styles such as total quality management (TQM), supply-chain management, database management. In addition, answers to questions such as how information technology in the field of pediatrics, can help parents and communities to sustain a better living are given.

Significance of the study can be attributed to its comprehensive and holistic approach to the use of information technologies by pediatricians of İzmir and the management side of using these technologies as well as the level of technology literacy and tendency for technology use among pediatricians in İzmir. It is also the first study done on the subject matter, in İzmir region. The study will give the audience a clear idea of parameters such as the barriers to EMR adoption faced by the pediatricians and tendency among them for new technology adoption.

The research is designed to include a sample of pediatricians from five different districts (suburban areas) of İzmir regarding their population size, contribution to the province's gross domestic product (GDP), and the number of health care units within the district. The method of selection employed during the course of the study is stratified sampling in which a sample size of 61 specialists are chosen from five different districts according to their calculated adjusted weighted averages in relation to the indices. The study makes use of three different indices: population index, healthcare unit index and GDP index. There are 28 districts in each index, which are evaluated on the basis of their

population size, contribution to the GDP of the province and the number of healthcare units within each district. An index value is calculated for each district in terms of listed parameters. Calculated index values determine the ranking of the districts in each listing. For each index, districts are ranked according to their index values. Population, Gross Domestic Product (GDP), and healthcare unit index values are calculated by dividing the relative population size, GDP, and the number of healthcare units of the district by the provincial population size, provincial GDP and provincial healthcare unit totals respectively and multiplying them by hundred in order to find out the percentage values.

| Districts | Population Index |
|---|---|
| Konak | *24,88* |
| Karşıyaka | *14,19* |
| Bornova | *12,71* |
| Buca | *10,16* |
| Ödemiş | *3,61* |
| Çiğli | *3,47* |
| Menemen | *3,20* |
| Bergama | *2,89* |
| Torbalı | *2,64* |
| Gaziemir | *2,57* |
| Balçova | *2,12* |
| Kemalpaşa | *2,07* |
| Tire | *2,07* |
| Menderes | *1,71* |
| Aliağa | *1,57* |
| Narlıdere | *1,38* |
| Kiraz | *1,34* |
| Bayındır | *1,19* |
| Urla | *1,09* |
| Selçuk | *0,93* |
| Kınık | *0,80* |
| Dikili | *0,75* |
| Seferihisar | *0,59* |
| Çeşme | *0,56* |
| Foça | *0,49* |
| Güzelbahçe | *0,41* |
| Beydağ | *0,41* |
| Karaburun | *0,21* |

**Table 1.** Population Index for Districts of İzmir Province.

| District | GDP Index |
|---|---|
| Konak | *19,5* |
| Bornova | *13,9* |
| Aliağa | *13,33* |
| Karşıyaka | *11,52* |
| Buca | *6,11* |
| Ödemiş | *4,13* |
| Torbalı | *3,45* |
| Kemalpaşa | *3,12* |
| Menemen | *2,85* |
| Balçova | *2,2* |
| Gaziemir | *2,1* |
| Tire | *2,08* |
| Çiğli | *1,96* |
| Menderes | *1,95* |
| Güzelbahçe | *1,51* |
| Bergama | *1,5* |
| Çeşme | *1,27* |
| Kiraz | *1,26* |
| Urla | *0,9* |
| Selçuk | *0,81* |
| Bayındır | *0,74* |
| Narlıdere | *0,71* |
| Beydağ | *0,65* |
| Foça | *0,64* |
| Seferihisar | *0,58* |
| Kınık | *0,52* |
| Dikili | *0,41* |
| Karaburun | *0,3* |
| Total | *100* |

**Table 2.** Contributional Gross Domestic Product (GDP) Index for Districts of İzmir Province.

| District | Healthcare Unit Index |
|---|---|
| Konak | *23,15* |
| Karşıyaka | *7,72* |
| Bornova | *7,72* |
| Ödemiş | *6,38* |
| Buca | *4,70* |
| Bergama | *4,70* |
| Çiğli | *4,36* |
| Menemen | *3,69* |
| Torbalı | *3,69* |
| Kemalpaşa | *3,36* |
| Menderes | *3,02* |
| Urla | *3,02* |
| Tire | *2,68* |
| Gaziemir | *2,01* |
| Balçova | *2,01* |
| Aliağa | *2,01* |
| Kiraz | *2,01* |
| Foça | *2,01* |
| Bayındır | *1,68* |
| Selçuk | *1,68* |
| Seferihisar | *1,68* |
| Kınık | *1,34* |
| Dikili | *1,34* |
| Narlıdere | *1,01* |
| Çeşme | *1,01* |
| Güzelbahçe | *1,01* |
| Karaburun | *0,67* |
| Beydağ | *0,34* |

**Table 3.** Health Care Unit Index for Districts of İzmir Province.

Finally, an adjusted weighted average for each district is calculated on the basis of given indices (See Table 4). While determining adjusted weighted averages, relative weight is assigned to each parameter. Population is assumed to be the most important factor in determining the adjusted weighted average, thus given a weight of fifty percent followed by the two equally important factors GDP and the number of health care units which are given a weight of twenty-five percent (See Table 5).

| District | Adjusted Weighted Average |
|---|---|
| Konak | *23,10* |
| Karşıyaka | *11,90* |
| Bornova | *11,76* |
| Buca | *7,78* |
| Aliağa | *4,62* |
| Ödemiş | *4,43* |
| Çiğli | *3,32* |
| Menemen | *3,24* |
| Torbalı | *3,10* |
| Bergama | *3,00* |
| Kemalpaşa | *2,65* |
| Gaziemir | *2,32* |
| Tire | *2,23* |
| Bal.çova | *2,11* |
| Menderes | *2,10* |
| Urla | *1,52* |
| Kiraz | *1,49* |
| Bayındır | *1,20* |
| Narlıdere | *1,12* |
| Selçuk | *1,09* |
| Foça | *0,91* |
| Kınık | *0,87* |
| Seferihisar | *0,86* |
| Çeşme | *0,85* |
| Güzelbahçe | *0,83* |
| Dikili | *0,81* |
| Beydağ | *0,45* |
| Karaburun | *0,35* |

**Table 4.** Calculated Adjusted Weighted Averages for Districts of İzmir Province.

| | |
|---|---|
| **Weight of Population** | *0,50* |
| **Weight of No. of Health Care Units** | *0,25* |
| **Weight of Gross Domestic Product (GDP)** | *0,25* |

**Table 5.** Subjective Weights Assigned for Each Parameter.

Five districts are chosen among twenty-eight on the basis of their calculated adjusted weighted averages. These districts should be selected to most likely represent İzmir metropolitan. For this reason, districts of Konak, Bornova,

Karşıyaka, Buca, Güzelbahçe and Narlıdere are picked for research purposes. The sample size is stratified among these five districts on the basis of their adjusted weighted averages. Adjusted weighted averages for these districts are added together to find out a total value. This total value, then is used for calculating the sample size to be taken from each district. Relative adjusted weighted average for each district is divided by the total value in order to find out the relative percentage value for each district on which the sample size will be calculated. Finally, the sample size of 61 is multiplied by this percentage value in order to determine the number of pediatricians who will be the reason for this study. Accordingly, 25 pediatricians from Konak, 7 pediatricians from Buca, 5 pediatricians from Güzelbahçe and Narlıdere in aggregate, 12 pediatricians from Bornova and 12 from Karşıyaka are chosen.

For data collection reasons, a prospective cohort study is chosen. A questionnaire composed of close and open-ended questions is designed for collecting data from pediatricians on their personal background, whether they are making use of patient follow-up (Electronic Medical Record Keeping) software or not, for what reason the software is utilized, software related issues, advantages of using such software and whether they are in need of or likely to use a web-based model or not. To initiate the investigation, a list of pediatricians, working in İzmir province, is obtained from İzmir Medical Chamber. The list is short of providing names and contact information of doctors working in all five districts chosen for study purposes. In fact, it only provides names and contact information of those pediatricians in Konak region. For this reason, another list is obtained from Ege University Department of Pediatrics providing names and addresses of

pediatricians practicing in other regions. This list is originally published by the Turkish National Association of Pediatrics, thus it is certified for official use. Pediatricians who have their own private offices are chosen randomly and called on the telephone. A question of whether they make use of patient follow-up software in their offices, is asked during the telephone calls in order to include both types of specialists in the study. Each pediatrician is visited for a demonstration of the internet-based model and conducting the survey. The questionnaire is put on the internet to be electronically administered. During each visit, answers to the questions are submitted on a computer platform. The reasons behind one-on-one interview are to demonstrate the software to the full extent and to maintain personal contact for learning their opinions on the patient follow-up software if they are using one and to make an investigation on the software that they use. A close watch on the patient follow-up software is necessary to find out similarities and common points of use.

## 1.2 Electronic Medical Record Keeping Systems and Its Use in the Field of Pediatrics: Theoretical and Empirical Links

### 1.2.1. What is a Patient Follow-up (EMR) Software?

Electronic medical records are confidential computer based records that is kept for each patient by a healthcare professional or organization. It contains the patient's personal details (such as name, address, date of birth), a summary of the patient's medical history, and documentation of each event, including symptoms, diagnosis, treatment and outcome. Relevant documents such as laboratory test results, MR, CT and X-ray results are also included. Typically, a single institution or agency controls this information, which is accessible only to authorized personnel. The main reason behind keeping electronic medical records, is to provide a summary of a person's contact with a healthcare provider and treatment provided to ensure appropriate healthcare. Information from electronic medical records also provides the essential data for monitoring patient care, clinical audits and assessing patterns of care and service delivery. Besides, electronic medical records form the first hoop in the information chain leading towards statistical analysis. There is no doubt that the ready availability of well organized, legible, accurate and comprehensive clinical notes can play a very significant role in the clinical decision making process and assisting in the provision of quality healthcare. In general, medical records should enable ("Electronic Medical Records"):

- enable health professionals to review previous care events, to reach timely and appropriate clinical decisions, and to develop treatment plans that minimize the risks and maximize the potential benefits to the patient

- provide an archival and legally acceptable record of the steps that were taken - when, why and by whom - in the care of an individual
- enable staff to audit the care provided to an individual
- provide material for researchers studying the etiology, natural history and cost-effective approaches to treatment of specific conditions
- act as a source of information which will enable various administrative functions of the healthcare service unit (such as contract management or coded statistical returns) to be carried out automatically as a by-product of the clinical data collected
- be stored in such a way as to ensure that the data are secure from loss, alteration or damage
- be subject to access controls that ensure patient privacy is adequately protected, and that the risk of disclosure to unauthorized persons is minimized.

Paper-based medical record keeping has some shortcomings compared with the electronic-based medical record keeping. First of all, finding and reusing data from paper-based medical records is tremendously cumbersome and costly. It is difficult to find specific items of information in it. Secondly, the growing need to share patient information between healthcare providers makes it difficult for the patients to keep track of their paper-based records. Paper records can only be in one place at a time and logistical issues make it difficult to move it around as fast as is needed. In practice every healthcare unit has a separate record for each individual, thereby creating a serious problem of record fragmentation

and dis-integrity("Electronic Medical Records"). This in turn might cause a problem on the patient's side in terms of receiving quality health-care as well as restricting their mobility between healthcare institutions. Electronic exchange of patient information is rapidly developing due to its potential for saving time and money on both the healthcare provider's sand the patient's side. Monetary and time-related costs are often disregarded or not recognized in the short-run and they are surely quantified in the long run.

Electronic medical records (EMR) use a blend of technologies to replace paper-based medical records. The technology depends on the location and purpose of use, but could include enterprise systems, clinical data repositories, wireless applications, or handheld units. Once a shift to EMR begins to take place the possibilities for technology-enhanced features becomes almost limitless. While the possibilities may be unlimited, examples of fully integrated systems are relatively finite; suggesting that we are at the beginning of a state of healthcare that is just beginning to alleviate our paper dependence.

The pediatric health care industry stands to realize dramatic improvements in both efficiency and effectiveness by a migration to digital records. Furthermore, beyond simple financial gain, secondary effects include improvements in such areas as primary patient care and long-term medical research. Clear advantages can be gained through a careful implementation process. The implementation should be incremental with each phase forming a further step within a given pediatrician's adoption and gradual move from one stage to another.

### 1.2.2. What do EMR Systems mean for the Field of Pediatrics?

Pediatricians deal with information to help children. They use time and expertise to interpret medical information. The average encounter is 12 minutes with a patient in which the average time to first interruption is 18 seconds. Following these encounters, 75% of patients leave with unanswered questions since there is usually little time to do all that needs to be done. Improved efficiency in assembling, processing, and acting on information, enables pediatricians to help children better. Pediatricians get paid for making decisions just like any other physicians. However, they do not get paid for looking for charts, documenting information in a chart, searching for information in a chart, writing out school reports. Basic features expected from an EMR system can be prioritized under three major categories: essential, desirable and optional features. Essential priorities include child specific needs such as growth charts and immunization calendars as well as features such as ease of data entry and messaging. Desirably, pediatric EMR systems are expected to have a lab interface, scanning management with document review and reporting features.

Electronic medical record keeping (EMR) systems, which are usually designed for adult care, must perform certain functions to be useful in pediatric care (Lustig et al. 513-515). These systems are now available to pediatricians world wide. An essential function of a pediatric EMR system is to facilitate care that is accessible, family-centered, continuous, comprehensive, coordinated, compassionate, and culturally effective-termed the "medical home" (513). The purpose of EMR systems is to compile and centralize all pertinent information related to a child's medical and non-medical care to ensure that optimal pediatric

care is provided. By this way, EMR systems have the capacity to improve the quality of care that children receive from their primary care pediatrician as well as from ancillary health care professionals.

There are established standards for recording, storage, and transmission of patient data. These standards are recognized by international organizations. However, commercial vendors sometimes overlook the special needs of pediatric practice. The small size of the pediatric EMR market makes it impractical for many vendors to design and maintain systems which address all of the requirements needed by the pediatricians. Thus, pediatricians are often faced with using a system originally designed for adults.

Common attributes of computer-based patient records are all vital for pediatric records. These include problem lists, measurement and recording of health status and functional level, statements about the logical basis for all diagnoses and conclusions, linkage with all of a patient's clinical records across settings and time periods, assurance of confidentiality, widespread accessibility, selective retrieval and formatting, linkage to local and remote knowledge sources, decision support, and flexibility and expandability to meet evolving practice needs (513). The set of requirements or desirable features for pediatricians when evaluating EMR systems can be classified under three different categories (514):

Data representation;

- Growth Data
- Patient Identifier

- Special terminology and information
- Age-based normal ranges
- Time of birth

Data processing;

- Prescribing of medications
- Immunizations
- Parent's special documentation requirements
- Reporting

System design;

- Special privacy issues; adolescent privacy, genetic information, guardianship data, social security data
- Family member links

For data representation reasons, following points are important:

Growth data; Representation of children's growth in pediatric practice is essential for any pediatric EMR system. Recording, graphic display, and special calculations of growth patterns is a critical function. The system should allow displaying and comparing a child's growth percentiles and body mass index with normal ranges. Growth measurements in terms of height, weight and head circumference are important and used exclusively for care of pediatric patients.

Patient identifier; A universally accepted patient identifier is a desirable but as yet

unachieved goal. Patient's name and surname, birth date, gender, and blood type are all desirable identifiers which must exist in any EMR system.

Special terminology and information; Special terminology and concepts that are used in pediatric care are needed to be included in an EMR system. Terminology describing pediatric preventive health care (e.g., developmental milestones, educational progress, and anticipatory guidance) and physical findings (e.g., weak cry, difficulty in crawling, bulging anterior fontanelle) should also be included as a part of the system.

Age-based normal ranges; Normal ranges for vital signs and other physiologic parameters change with a child's age. For this reason, pediatric EMR systems should allow the user to easily compare a patient's vital signs with age-based normal ranges. The same is true for laboratory values, however normal ranges for laboratory results are usually supplied by the reference laboratory and not the EMR; the EMR should be able to accept normative values provided by the reference laboratory.

Time of birth; The time of a child's birth is important in calculating exact age in the first days of life and should not be omitted from EMR systems.

In terms of data processing, following points are required:

Prescribing of medications; This process is based on the age and weight or body surface area of the child. Pediatric dose calculations of drugs based on available data are essential for pediatric care.

Immunizations; Efficient recording (data input) and effective display of immunization calendar are essential. System design should allow easy updating as recommendations change. For effective interaction with immunization registries, the ability to flexibly format immunization data and support electronic data interchange with registries is vital. Systems should be able to provide immunization reports based on reminder systems to prevent missed immunizations would be desirable.

Parents' special documentation requirements; Parents may ask to review or append chart information about their child's health. In developed countries, regulations that dictate procedures and limitations of parental appendices to a child's chart are clearly set forward at the federal level. However, there is no indication that the same rule applies to our country.

Reporting; EMR systems should have the ability to easily customize reports to match mandated formats (e.g., school or physical education camps or reports to school nurses) would be particularly valuable to pediatric practitioners.

In designing EMR systems, following require special attention;

Special privacy issues;

* Adolescent privacy: Privacy laws regarding adolescents' medical information (especially sexual and mental health and behavior issues) are extremely important while designing EMR systems (514). Patient follow-up systems must be able to respond to these privacy needs by allowing restriction of access to this

information according to these laws and policies.

* Genetic information: Patient follow-up systems must provide protection of information on a patient's genetic information, including newborn metabolic screening results (514).

* Guardianship data: A child's guardian may be different from his or her biological parents, and EMR systems should be able to reflect this.

* Social security data: Information about the guardians' social security institutions as well as their social security numbers are needed to be protected.

Family member links; EMR systems should be able to maintain links to records of other family members in the EMR system. This feature is required at the clinical level, however it is optional for pediatricians working alone.

Contemporary pediatricians that practice in multiple environments such as hospitals, private offices, emergency clinics, private or public organizations are faced daily with a high volume of cases that are documented on paper. Unfortunately, in a vital healthcare industry, primary care pediatrics as well as many other fields of medicine, lacks a unified standard. Use of EMR systems in pediatrics held the potential for serving the patients in the best and the most efficient way possible. However, there are many factors that contribute to pediatricians' slow incorporation of technology to their daily practices. Probably, the most important one is the high cost of technology relative to pediatric reimbursement. In addition, many pediatricians do not have the time to dedicate

to the design and implementation of an efficient computer system, due to the lack of any formal computer education. There are various computing tools that can be used in many facets of pediatricians' practice. These tools can allow pediatricians to monitor their patients' growth and development electronically as well as automating routine procedures such as referrals, progress notes, medication information, immunization, and school health forms. Patient images, graphics and x-rays can be stored as part of the permanent electronic medical record (Bates et al. 1-10). Educating patients as part of a preventive care program can be multimedia-based allowing the pediatrician to inform his/her patient population prior to their visit to the pediatrician's office.

Medical informatics will also allow patients to constantly improve their continuing medical education in an interactive format using a computer. In addition to medical education, computers allow for the flexibility to remove all the material available in textbooks and provide them in an electronic format. In practice, among implications of using an online computer textbook format come robust search capabilities on any medical topic, as needed in daily practice.

Migration from a paper-based system to an EMR is what is happening out there. The advent of computer technology has allowed primary care pediatricians to provide a more organized approach to documenting patient visits. The decision to migrate to an Electronic Medical Record system from a paper-based system in a physician's office will probably require the assistance of a computer expert. In parallel to the development of EMR systems, the explosive growth of the internet and the world wide web has provided primary care practitioners such as pediatricians to access inexpensive software and hardware tools. The pediatrics

network on the internet comprises databases, publications, pediatric practices, parent support groups that focus on the health care of children. E-mail is being widely used as a means of informal personal contact with patients and families that a home visit used to provide. The internet is also being used as a medium of exchange which allows primary care pediatricians to discuss patient cases with other specially trained pediatricians located across the country. The web offers a pediatrician access to clinical information that can be further distributed via e-mail to their patient population (Caban-Martinez, and Caban-Alema). Perhaps the most popular use of the internet for pediatricians is a mailing list where each person on the list receives an identical copy of each piece of mail sent to the list (Caban-Martinez, and Caban-Alema). Mailing lists or listservs allow a group of pediatricians to communicate practice management issues with other pediatricians in the same situation.

Storing, retrieving and transmitting patient information in an electronic environment presents hazards both in terms of increased availability of that information to unauthorized parties and in terms of that information not being available when needed because of system failures. Therefore, a clear set of security regulations must be in place to ensure that electronically stored information is available to those who need it, when they need it, that it is properly authenticated, and that it is protected from use of disclosure by unauthorized persons.

### 1.2.3. What kinds of Electronic Medical Record Keeping Systems Software are in Use for Pediatricians?

The impetus for using EMR systems stems from the potential to improve healthcare along a number of dimensions, including: costs, productivity; clinical outcomes, patient satisfaction, physician satisfaction ("Introduction to Electronic Medical Records").

Possible EMR solutions include: point solutions, internet-based solutions, enterprise solutions, network solution. Medical or healthcare informatics is the field of science that deals with all aspects of understanding and promoting the effective organization, analysis, management, and use of information and technology in health care (Martinez, and Alema 198).

Internet-based EMR systems are the most recent and unconventional type of software developed for the use of pediatricians. Physicians using this approach rent a virtual Internet-based chart rack which costs several hundred dollars a month for each user. Data are theoretically secure, and most systems have easy-to-navigate screens that build a coherent patient note. Although some of the data may reside on local hard drives (which can crash), the whole database exists in cyberspace on a different computer (which also can crash) (Schuman). If the Internet connection dies, so does access to a physician's vital information unless you had the good sense to print out all information generated. For instance, E-Compukid is one of the new internet-based EMR which provides a fully functional, Internet-based system delivered directly to a pediatrician office's computer network. Physicians and staff use portable Windows CE-based computers that communicate with each other over a wireless network. The

program logs in patients and stores their vital signs. Using a template, the staff can enter encounter notes and print out prescriptions, office notes, and lab and radiographic reports. E-Compukid also integrates an Internet-based billing system with word processing software and online access to resources, such as the American Academy of Pediatrics's *Redbook* and the *Physician's Desk Reference* (Schuman). E-Compukid is very good at tracking data and bringing important information, such as missed immunizations or a patient's drug allergies, to your attention. Internet-based electronic patient follow-up software are cost-effective in terms of software maintenance and upgrades because both software maintenance and upgrading are done behind the scenes over the internet.

In general, Web-based EMR systems are affordable, not only in terms of the initial outlay but in maintenance and hardware support as well. For a stand-alone EMR system, hardware support alone can cost several hundred dollars per month. To install one for a four- or five-person clinic, you'll need a server, workstations, a network, backup hardware and tapes, and expensive software, including a maintenance contract. And you may have to hire a part-time technician to install and periodically maintain your server and hardware. Initial costs, including training, are likely to exceed $100,000 (Bergeron).

A Web-based EMR may be difficult to beat, not only in cost but also perhaps in performance and features. Once you make the decision to use a Web-based EMR, there's no 6-week delay to obtain and set up hardware and software. You simply point your Web browser to the EMR site, log in using your name and password, and start interacting with and personalizing your EMR. Some Web-based EMR systems use a hybrid approach, wherein the EMR

program is run locally, but your patient data are still stored at the vendor's site. Using a Web browser, records can be added or edited on the fly reducing transcription costs and narrowing turnaround time. The result is being able to do more in less time without compromising patient care (Sullivan et al.).

This centralized data store can be a boon if you travel from clinic to clinic or do a lot of work from home. As long as you can get connected to the Web, you can access your patient data, regardless of location. In addition, some vendors offer to analyze your patient data (e.g., number of patients admitted over the past few days or weeks; breakdown of population by diagnosis, age, sex), often at no charge. In fact, some vendors are marketing their EMRs as a giveaway, as long as you agree to leave your patient data in their hands.

Some of the internet-based pediatric EMR systems also allow access to online resources which include medical reference, journals and guidelines, research data, business news and family/child-related information. The good thing about the pediatric internet is that it supports evidence-based medicine. Evidence-based medicine can be defined as the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. Pediatricians can find information on drug indications, dosages, interactions, adverse reactions as well as treatment methods and diagnosis. An internet connection, basic knowledge on how to use internet search engines, portals and directories and knowing how to ask questions to get the answers are all the necessary things that a pediatrician has to know in order to use the pediatric internet. Free resources include governmental resources, organizational resources, university resources, commercial resources, web portals

and personal digital assistant tools. Internationally accepted organizational resources include American Academy of Pediatrics internet sites such as:

- AAP Policy Statements, Clinical/Technical Reports:
  - http://www.aap.org/policy/pprgtoc.cfm
- Pediatrics, Pediatrics in Review
  - http://www.pediatrics.org
  - http://www.pedsinreview.org
- Most favorite university resources include internet sites such as: GeneralPediatrics.com (U. Iowa):
  - http://www.generalpediatrics.com
    - Problem-based resources
- Harriet Lane Links (Johns Hopkins):
  - http://www.harrietlane.org
    - Reviewed resources from the WWW
- DermAtlas (Johns Hopkins):
  - http://www.dermatlas.org
    - Searchable pictorial atlas of skin disease

Pediatric web portals include:

- Pedialink (AAP):

  - http://www.pedialink.org
  - Medical resources linking to CME
  - Physicians Online:
  - http://www.pol.net
  - E-mail, job board, CME, patient care/business news

- eMedicine:
  - http://www.emedicine.com
  - Free and premium versions
  - Online medical text, formulary, patient information

- MDConsult:
  - http://www.mdconsult.com
  - $200 per year
  - Nelson's, AAP Red Book, full-text journals

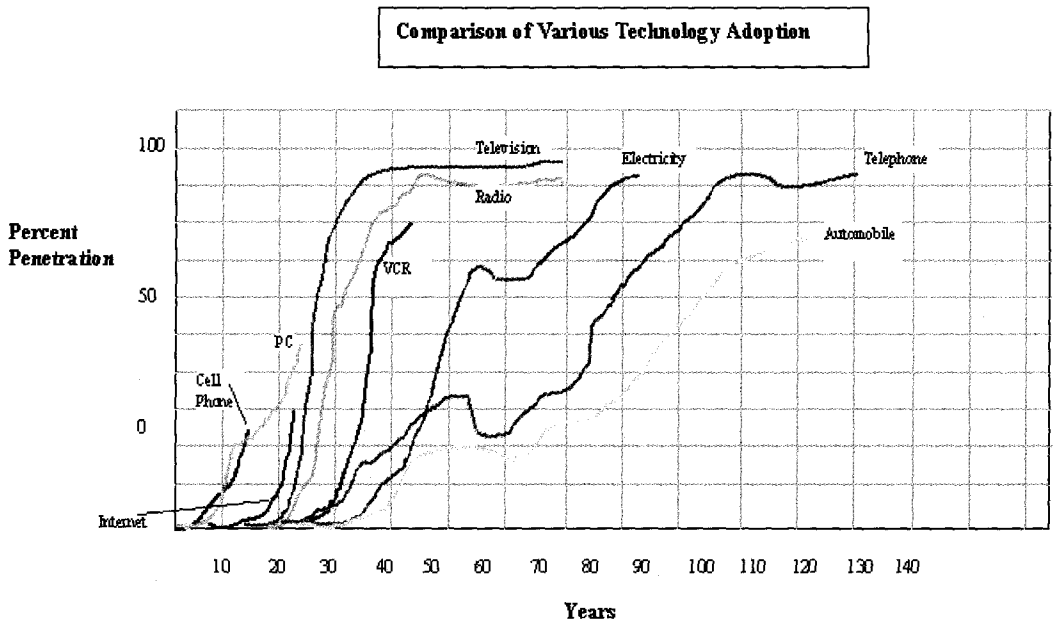
Network solution or the "streamlined solution" makes much more sense to physicians who believe the true goal of an EMR is to make the office as paper-free as possible. In this system, all software operates from a server linked with client computers. Networking options now include a wireless portable or laptop computer. Data are backed up many times daily, and all patient information exists in the computer database. Schuman reports that costs vary from just a few thousand dollars to tens of thousand of dollars, depending on the system chosen.

### 1.2.4. The Management (Administrative) Dimensions of using Such Systems and Barriers for Adopting EMR Systems

"*Many assume the healthcare industry is afraid and slow to adopt technology*" says William Jesse, the president of the Medical Group Management Association (MGMA) (Helzner 1). However, the results of a survey conducted by the Medical Group Management Association (MGMA) and Pfizer Health Solutions, entails that this in fact not the real case. The results of the survey prove that healthcare is realizing the importance of technology and is embracing it to improve productivity and patient satisfaction. Survey findings indicate that more than 21% of healthcare providers have implemented electronic medical record (EMR) systems and many are considering deploying such systems in the near future (2).

Majority of barriers to the implementation of EMR systems are behavioral and organizational rather than technological (Lee 1-20). Many people believe that physician resistance is the most significant of all behavioral barriers to adoption and diffusion of the electronic patient follow-up systems. Others believe that economical and legal considerations hinder even the most progressive physicians. Researchers argue that physicians have special concerns related to using Electronic Medical Record Keeping systems. Some of the challenges facing physicians include patient non-compliance to follow-up plans, co-ordination of care: specialty referalls, proliferation of outpatient tests and procedures, increased expectations from patients: early diagnosis of illnesses and timely communication of test results, and protection of personal privacy. Among these, physicians have cited confidentiality and loss of personal privacy as reasons for not embracing the

EMR (Lee, 1-20). Others believe that physicians are resistant to the social change that will result from implementing EMR. The reason for this is that they will need to alter practice patterns and experience changes in the physician/patient relationship to accommodate the technology. The investigation made on the pediatricians reveals similar findings in our study. Some of the pediatricians showed similar behavioral patterns. Anderson and Jay state that the adoption of technology among physicians is dependent upon physician networks, with the opinion leaders serving a key role in the technology adoption process (Anderson, Jay, and Anderson 292-93). *"One thing is certain, an EMR system cannot be effective unless the individual users adopt and use it".* In reality, many external factors can influence an individual's perceptions of an electronic patient follow-up software. However, Lee suggests that at the core of adopting technological innovations lies the individual's decision to use the innovations or not to use them. Diffusion of innovation takes time. Innovators and early adopters are usually the ones who get the advantage and eat the apples first. Some of the other barriers include low profit margin on the healthcare provider's side, vendor issues, user concerns and complexity of pediatric care.



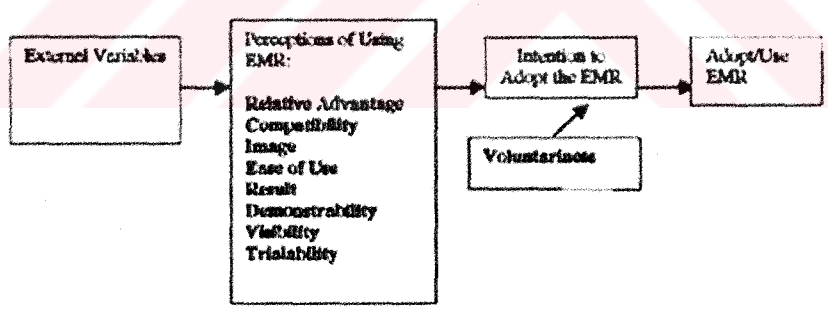

Source- "The Need for Electronic Medical Records in Primary Care" American Medical Informatics Association Annual Symposium, November 12,2002.

**Figure 1.** Comparison of Various Technology Adoption

In 1991, Moore and Benbasat published a paper describing their work in the development of an instrument to measure users' perceptions of adopting an EMR system (Lee 1-20). Accordingly, eight constructs are defined (8):

1. Compatibility
2. Ease of use
3. Image
4. Relative advantage
5. Result demonstrability
6. Trialability
7. Visibility
8. Voluntariness

Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, needs and experiences of potential adapters. Ease of use as being the second factor, refers to the degree to which an innovation is perceived as easy to use. Image being the third factor refers to the degree to which an innovation is perceived as adding to the user's social approval. Relative advantage is the degree to which an innovation is perceived as being superior than its precursor and the degree to which it is perceived as useful. Result demonstrability refers to the degree to which an innovation is perceived to be available for demonstration. Trialability is the degree to which experimentation with an innovation prior to adoption is perceived as possible. Visibility refers to the degree to which an innovation is perceived to be used by others. The last construct being the voluntariness refers to the degree to which use of an innovation is perceived as being voluntary, or of free will.




Source: Lee, Frances Wickham. "Adoption of Electronic Medical Records as a Technology Innovation for Ambulatory Care at the Medical University of South Carolina" Topics in Health Information Management, Vol. 21 Issue 1, August 2000, pg 1-20.

**Figure 2.** Instrumental Approach developed by Moore and Benbasat to measure users' perceptions of adopting an EMR system.

In the past, the combination of extra cost, start-up complexity, staff training, and fear of downtime has kept most physicians from switching to an electronic medical records system (Schuman). In recent years, the growth in

technology has changed things for the better. Computers have become much less expensive, disk drives are more spacious, and operating systems can now be used with confidence by even the most technologically challenged. Schuman claims that electronic patient record keeping systems eliminate the need for the paper chase. He states that all pediatricians have a paper-based system in place to expedite and track patient visits, radiographic reports, telephone calls, and referrals, in addition to generating prescription refills and making referrals. He adds that unless a pediatrician's practice has already migrated to an EMR, chances are pediatrician's office's "system" calls for dozens of encounter sheets, telephone message forms, school physical forms, vaccination forms, and other paper records. Copiers work overtime, and charts are bursting at the seams. The benefits of an EMR system are numerous with presenting physicians with a new "paradigm" for care. With the help of an EMR system information about a patient's medical history, active and inactive problems, vital signs, lab values, and consultant reports can all be seen by the physician on the screen with a few clicks of a mouse. The program can be set to throw up a red flag when, for example, a lab report needs to be reviewed, an action is required, or a follow-up visit is called for. Best of all, a good EMR prints *legible* prescriptions, school notes, lab order forms, super bills, and referral letters (Schuman). These systems have the ability to make pediatricians become more organized and paper-free. A profound realization of the studies done on the use of EMR systems is the ability of these systems to increase workflow significantly. An EMR can reduce patient-management time and errors, and can augment physician's bottom line by helping increase their patient load through enhanced efficiency.

Perhaps, one of the most important barriers in front of the adoption of EMR systems is the high switching cost from a paper-based record keeping system to a digital record keeping system. Moving from paper to an electronic medical record is a huge task, especially if physicians have to transfer all patient-related information themselves. It becomes a big hassle for the physician to retransfer every bit of patient related information into an electronic format. Dr. Jim O'Connell states:

*"Moving from paper to an electronic medical record is a cumbersome task, especially if physicians have to transfer the information themselves. It felt awful for the first few months; now I do not know anyone who would give it up. We do a better job of protecting patient confidentiality with the EMR than we do with paper records."*

Computerizing and automating a practice is not necessarily a pain-free fun process, but with careful planning, it can be immensely less painful. The first thing to think about is the time frame for making the transition, whether it is from paper to computer or from one computer system to another. The estimated time frame will depend on the size of the practice and the type of implementation planned. As a rule of thumb, you can expect it to take six to 24 months to complete the process, from initial planning to "going live" with the new system ("How to Select a Computer System for a Family Physician's Office"). In addition to calendar days, making this change will require staff time, training, entering data and enduring such temporary inefficiencies as running parallel systems. One misconception is the "fear of obsolesce." The thinking goes something like this: "Why spend all of that time automating the practice when the equipment becomes outdated as soon as it is installed?" Yes, technology is constantly changing. In fact, an industry estimate is that computer technology

doubles every 18 months ("How to Select a Computer System for a Family Physician's Office"). However, from a technical perspective, the typical life span for computer equipment is three to five years.

The second consideration is money. It is inevitable that automation will increase revenue and productivity in the practice and that a physician's investment will be recouped in a relatively short time. Purchasing a system might be a problem for some physicians in the short-run, thus an alternative to purchasing might be to consider leasing. There are definite advantages and disadvantages to leasing. Pros include improved cash flow, potential tax benefits and the possibility of a better purchase price. Cons include being locked into a lease and not being able to update the equipment, high finance rates, and the possible loss of such tax advantages as writing-off depreciation. Other considerations include finding out if the lease can be paid off early and who is responsible for paying taxes, insurance, freight, set-up, installation, etc.

The third consideration is reengineering the practice. Indeed, a work flow analysis of the pediatrician's practice is what is needed. During the work flow analysis, all operations including both front and back office should be examined. Activities of patients can be tracked from the time they enter the office to when they check out. As this unfolds, a physician should be able to find opportunities to increase efficiencies in the way that certain tasks are performed. Some of the administrative issues include ("How to Select a Computer System for a Family Physician's Office"):

- How is patient information collected and updated?
- How long do patients have to wait beyond their appointed time?
- How is a patient's chart pulled and routed?
- How much time does the physician spend with patients for varying types of appointments?
- How much time and money is spent on dictation and transcription? How quickly are transcriptions turned around?
- How are prescriptions managed--both new and refills?
- Do patients receive any type of information or educational materials?
- What method is used for logging in lab tests? How are physicians and patients notified of the results?
- How a re p atients recalled/reminded for preventive services appointments?
- How are medications (both samples and controlled substances) managed?
- Where does a patient's chart go after a physician is finished with
- How much time is spent tracking down misplaced patient charts?
- What happens to the encounter forms after patients have checked out?
- How are charges and payments handled?

As the practice operations are discussed, areas in which productivity can be increased should become apparent, which in turn, increases the practice's bottom line. These "productivity enhancers" will be the functions that the computer system can perform.

A commonly expressed barrier to the implementation of EMR systems is physician resistance; one component of which is concern for negative impacts on physician-patient relationships resulting from use of an EMR while the patient is present (Gadd, and Penrod). Several studies that have examined the anticipated and actual impacts of outpatient EMRs (featuring documentation, ordering, and results reporting) on patient care have identified physicians' concerns for the physician-patient interaction as a potential barrier to successful implementation. Other studies have reported a more positive physician response to the use of EMR systems. Gadd and Penrod conducted a research to identify significant concerns of physicians regarding implementation of an EMR in an outpatient environment, both prior to implementation and after 6 months of use and to assess patients' satisfaction with their outpatient encounters, including general and EMR-specific factors. For research reasons, a pre-implementation and a post-implementation physician surveys were conducted to assess physicians concerns for deploying EMR systems. Pre-implementation physician survey results indicated that the overall effect of the EMR would be beneficial to their practices average 0,79 on an EMR optimism scale of -2 to 2 (-2 = highly detrimental and 2 = highly beneficial) (Gadd, and Penrod). Prior to implementation, they claimed that their chief concerns about using an EMR were related to issues of physician-patient rapport, time to document and place orders, patients' satisfaction with quality of care received, overall quality of care delivered, and physician autonomy. Post-implementation physician survey results indicated that while they still perceived the overall effect of the EMR to be beneficial, their optimism was significantly decreased (Gadd, and Penrod). Following the implementation,

physicians' chief concerns continued to be the impact of the EMR on the time required to enter orders and document encounters on the rapport established between physician and patient during the visit. However, several decreases in individual item mean responses were significant, including patient privacy, the overall quality of healthcare that patients receive, and physician's autonomy. On the patients' side, a post-implementation patient survey was conducted to see what patients' reactions were to the new system. The results revealed that the impact of the EMR was very little on patient satisfaction. Patients reported that they did not perceive an impact of the EMR on communication or eye contact with the physician. Visits were felt to be more efficient because the doctor was using a computer.

Although the full range of electronic patient record keeping system's benefits will not become clear until more systems are implemented and more processes computerized, the market for EMR systems holds a promise for the days to come. EMR systems can already improve efficiency and quality. The costs of chart pulls can be eliminated. Providers can also receive decision support regarding the costs and selection of drugs, laboratory tests, and radiographic studies. By having decision support tools and information resources within the reach of a key stroke, pediatricians can continuously improve themselves. Other key benefits of using such systems include maximized time efficiency, reduced transcription expense, reduced chart supply costs and records storage space and no more lost charts. A scholar manifests that healthcare providers should be looking ahead and foresee the potential benefits of using such systems.

According to a survey conducted by the Task Force on Medical Informatics (Council on Pediatric Practice), to explore the use of computers in pediatric practices to store and process patient and financial information, the types of software programs most frequently used, and the use of computer technology for patient educational purposes, revealed interesting results. The sample size for the survey was originally 1,069 physicians, however analyses were based on responses only from 800 of these pediatricians who provide direct patient care in office-based or clinic-based settings. The survey results revealed an extensive use of computers in pediatric offices for some functions, as well as striking lack of use for patient education. However, a large proportion of pediatricians were not aware of their office computer system's specific software applications. Generally, pediatricians in group practice or hospital/clinic-based practices (representing 50% and 31% of pediatricians who provide direct patient care in office or hospital/clinic-based settings, respectively) were less likely to be aware of their computer system's software capabilities than pediatricians in solo or two-physician practices (19%) ("Periodic Survey # 36: Management Information Systems and Other Computer Technology in Office-Based Practice Settings"). Where there were high numbers of "don't knows", findings should be interpreted cautiously. Overall, the study has shown that 91% of pediatricians who treat patients in an office-based or clinic-based setting report their office used a computer system to store or process patient information, such as demographic, financial or clinical records. It was found out that pediatricians were more aware of specific applications that are more directly related to the care of patients than those that

are related to the business management or administrative activities of practice.

In general, more pediatricians reported that their office used computers for appointment scheduling, patient accounting and management reports than for managing patient care, managed care programs, or practice support and analysis. For appointment scheduling purposes, the majority of pediatricians responded that they used computers to register new patients (81%), to update demographic data when visits are scheduled (72%), print charge slips/labels for charts (60%), and process appointments on-demand (56%) ("Periodic Survey # 36: Management Information Systems and Other Computer Technology in Office-Based Practice Settings").

On the management side, four in 10 pediatricians said their computer system analyzes revenue by provider, payer, and service/procedure, while about the same proportion do not know. Nearly half of pediatricians did not know if their computers provided diagnosis utilization reports, track referral trends, track revenue trends and revenue by referring source, or other trend reports.

In terms of patient care features, most pediatricians claimed their office computer system did not have programs for patient care. Only one-third of pediatricians said their office computer system had the capacity to maintain a diagnoses or problem list, 28% claimed their system maintained other clinical records and can track immunizations by computer, and 24% said it maintained a medication list which included adverse drug reactions ("Periodic Survey # 36: Management Information Systems and Other Computer Technology in Office-Based Practice Settings").

For supporting their practices and making analysis on the outcomes, more than 4 in 10 pediatricians did not know if their office computer system had the software that provide any practice support and analysis functions, and an equally large proportion said it did not. Additionally, 14% of the pediatricians said it can track laboratory reports.

Access to internet and using on-line services was another important issue that was questioned in the survey. Accordingly, more than 60% of pediatricians said their computer currently had, or will have within the next 12 months, a modem and access to the internet. When asked about their computer system's capacity for electronic interface, 34% of pediatricians said their system currently had the capability of transmitting data directly to another external computer system, 11% was planning to add this capability within 3 years, and 45% did not know. Among all pediatricians whose office used a computer, 21% used it to electronically submit claims to insurers and 20% were using it to electronically submit claims to Medicaid; less than 15% of pediatricians were using their office computers in any other electronic interface capacity, including transmitting data to or accessing state immunization records (5%).

Patient education through computers in pediatric offices was another point raised during the conduct of the survey. As a result, it has been found out that computers were rarely used in pediatric offices for health education purposes.

From October 2001 through February 2002, a follow-up survey was conducted by the American Academy of Pediatrics Task Force on Medical Informatics, addressing pediatrician's use of computers at the office and at home. The sample size was 882 pediatricians this time. Results obtained from

the survey depicted that 97% of pediatricians personally used computers either at work or at home. 95% of these pediatricians use a computer at work whereas 79% of them use a computer at home. It has also been reported that the mean number of hours spent using a computer at any location is 12.6 hrs. per week ("Periodic Survey # 51: "Use of Computers and Other Technologies"").

Statistical findings on the personal use of internet/world wide web (www) showed that web is most frequently accessed from home rather than from work. Among the pediatricians surveyed, 44% of them used regular modem with phone line, 18% of them used DSL, 17% used cable modem, and 12% used an ISDN-BRL (Periodic Survey # 51). Daily use of web was the most frequent compared to weekly use of web: daily (50%), 4 to 6 times/week (22%), 2 to 3 times/week (16%), once a week (6%), and less once/week (5%). Primary reasons for not using the Web included lack of time (73%), lack of interest (30%), lack of comfort using Web (30%) (Periodic Survey # 51). Primarily, pediatricians use the web for gathering non-medical news and information (86%) followed by searching for medical information sources (85%) and literature (73%), personal purchases (70%), and professional association communication (54%).

Responses for e-mail use in the office were as follows: 14% of those pediatricians reported that they used e-mail to communicate with their patients. Within the responses, primary uses of e-mail included accepting requests for prescription refills (54%), communicating test results (41%), and scheduling appointments (37%). Additionally, 63% of these pediatricians communicate via standard e-mail whereas 16% communicate via a secure messaging system.

Respondents' reasons for not using e-mail to communicate with patients include: lack of physician time (52%), lack of office staff time (42%), concerns about privacy/confidentiality (45%, lack of interest in communicating via email (38%), too few patients with email (34%). In addition, 30% of the respondents stated that they used office e-mail to communicate with non-patients. 67 out of 882 pediatricians were questioned about whether they use a web page for their practice or not. As a result, 51% reported that they have a web page either for themselves or their practice. Among 882 pediatricians, 91% reported that they were using an office computer system that was storing and processing patient information. Remarkably, 41% of pediatricians reported their practice used computer software to manage a diagnoses or problem list; 37% said their office was tracking immunizations via the computer, and 36% said their medical office maintained other clinical records on the computer. Fewer than 30% of pediatricians reported using software for other types of patient care management. Additionally, 41% of pediatricians reported their office electronically submitted and received laboratory results, and another 39% claimed that their office electronically submitted claims for private third-party payers.

Security and confidentiality become serious concerns that are set front adapting EMR systems. Health data about individuals are among the most sensitive types of personal information. Computerized databases of personally identifiable information may be accessed, changed, viewed, copied, used, disclosed or deleted more easily by more people (both authorized and unauthorized) than paper based records. As the access to patient record is not

limited to those involved in the health care delivery and patient management, they can be retrieved and used secondarily for different purposes like: (a) *education (classroom teaching and conferences)*; (b) *regulation (limitation, post marketing surveillance and accreditation)*; (c) *commercial enterprises (development of biotechnology and marketing strategies)*; (d) *social services and child protection (medical records of spouse or child abuse)*; and (e) *public health services (reports on disease mortality and morbidity, partner notification and surveillance)* (Verma, 884-888). Since each of the searcher has different aim of search on the vast amount of health and personal information available on the information highway, there is every likelihood of breach in privacy. The confidentiality of medical information and the privacy of e-mail are paramount (Rind, Kohane, Szolovits, Safran, Chueh, and Barnett 139). E-mail can be an effective communication tool with the advantage that it: (a) circulates information efficiently; (b) enables thoughtful exchanges of medical information; (c) allows authorized receivers to save messages electronically or in paper form; and (d) can be linked to other educational websites (Verma, 884-888). However, e-mail in the medical context not only generates liability concerns but also raises serious questions about privacy, confidentiality, and authenticity of authorship and patient consent. E-mail poses threat to confidentiality as others can interrupt unsecured e-mail en route. Any one having access to a doctor's e-mail account can access, alter and even respond to an e-mail with the illusion of authority. Patients or physicians who use e-mail in the workplace for medical interchange are not assured of confidentiality and may potentially expose sensitive details of illness or social circumstances to an employer. Furthermore, patients who use family e-mail accounts at home may

lack privacy from spouses, children, or parents. Medical account addresses could be distinguished from other personal or professional ones. Medical e-mail addresses and the messages generated through them should be reliably documented in and linked to the patient's medical record. Such linkage can be accomplished in various ways, from simply including a patient identifier to embedding a hypertext link to a Web-enabled medical record. Although electronic communications must be protected from unauthorized interlopers, most violations of the confidentiality of electronic data are committed by authenticated parties. In order to prevent these breaches, education programs should be given on how to maintain security and confidentiality on the part authorized persons.

Hypotheses about the influence of internet usage and e-mail on costs and use of health services must be tested rigorously. Improved access to physicians may reduce the need for some visits. Enhanced communication about health promotion and disease prevention programs might affect vulnerability of patients for certain diseases and mortality rates.

Physicians are held liable to a great extent for responding instantly to e-mail messages from patients. For this reason, systems should be designed to alert physicians for incoming e-mails. Electronic receive-and-read receipts could show both physician and patient that important contacts were made.

Medical systems offering electronic medical communication should research and monitor rates of access within their diverse patient populations. Cost-effectiveness analyses should establish the medical and economic advantages to the system of patient access to internet and e-mail. The cost-

effectiveness of providing technology to targeted patient populations might be studied. Even if widespread access is achieved, interface design research is still critical. If patients are required to deal with complex, poorly designed end-user interfaces or interfaces that require a high reading level, whole segments of the population may be cut off from the benefits of the system. Multimedia capabilities such as voice and video captures of e-mail systems could improve access for patients who are not literate or for those who have disabilities.

The rate of the adoption of the EMR software appears to be related to the degree of urbanization of the physician practice market as depicted in Table 6 (Brailer, and Terasawa 19). The table shows that EMR adoption in major urban markets is 1.5 times greater than in small non-urban markets in the U.S.

| | Total | Non-metropolitan | | Metropolitan | | |
|---|---|---|---|---|---|---|
| | | <25,000 | 25,000-49,900 | <250,000 | 250,000-1 million | >1 million |
| **Mean** | 38,0% | 29,6% | 35,8% | 35,4% | 39,9% | 41,7% |
| **Median** | 25,0% | 10,5% | 21,0% | 25,0% | 30,0% | 30,0% |

Source- Brailer, David J.; Terasawa, Emi L. Use and Adoption of Computer-based Patient Records. Oakland: California Healthcare Foundation, 2003.

**Table 6.** Electronic Data Capture by Regional Population in the U.S.

The importance of EMR systems for managing administrative tasks and coordinating information flow within healthcare organizations is note-worthy in today's growing service economy. Some of the potential factors which might contribute to a business's success can be listed as follows:

- EMR use increases workflow significantly in a small business environment
- It reduces patient-management time and errors
- It improves the bottom line of a business as a result of enhanced efficiency

- It increases both patient and provider satisfaction
- It encourages evidence-based practice
- It reduces costs including both direct and indirect
- It improves communication between pediatricians and their patients
- Most important than all, EMR use saves time.

### 1.2.5. How EMR Technologies in the Field of Pediatrics can help Parents, Pediatricians and Communities to Sustain a Better Living?

The key domains of EMR benefit identified by the National Alliance for Primary Care Informatics are; availability, communication, operational savings, decision support in terms of reducing errors, improving guideline compliance, and reducing costs, quality measurement, satisfaction and efficiency. Availability can be interpreted as 24 hour, 7 day service in which patient medical information can be viewed by more than one user at a time and available from remote locations to covering medical doctors and others with appropriate needs. Additionally, the information must be legible by all parties when availability is considered. Communication between physicians, patients and other related parties with appropriate needs, is enhanced through instant messaging, ability to reach answers for frequently asked questions. Operational savings for practices through the use of EMR systems can be summarized as dictation cost savings, chart pull savings and those savings accrue to practice which apply to all payers. Decision support process is accelerated through the cost and time savings gained as a result of underlying mechanism use such as drugs, lab tests and radiological studies. In parallel, medication errors are reduced by a significant amount by the use of EMR systems. In terms of total quality management, EMR systems make it dramatically easier to measure quality by providing prevention and guideline adherence. Job satisfaction is very high after conversion to EMR systems. In terms of efficiency, electronic medical record keeping systems can actually save physician time significantly.

In the U.S.A, The National Academy for the Sciences released a study stating that more people die each year from medical errors than highway accidents, breast cancer or AIDS (Carpenter 48). As a precaution, automating routine procedures will reduce human error and increase safety. Improvements in safety would include:

- Providing reminders and alerts when patients need specific tests before a treatment or procedure
- Improving decision making- all physicians will have access to the same patient information

On the pediatricians' side, the benefits of using Electronic Medical Record Keeping (EMR) Systems can be classified under seven major categories. These are ("Electronic Medical Records"):

- Availability, transfer and retrieval
- Linkage
- Storage
- Data views
- Abstraction, reporting
- Data quality and standards
- Decision support

Availability, transfer and retrieval; Medical records that are electronically formatted can be readily accessed from anywhere, local or remote, across a world area network or a communications link. Data that are stored in electronic formats can be retrieved electronically: literally billions of records can be sifted through in

seconds if the database has been appropriately designed and indexed. More than one user at a time can have access to them, and all service providers can share the same records.

Linkage; Medical records belonging to any patient, made by multiple providers in different locations and units can be brought together and shared to create a single record for the individual. By this way, the problem of record fragmentation can be resolved, and patient care can be genuinely shared between providers. Furthermore, all the data in graphical format, incoming letters, and audio-visual data relating to a patient can be linked to their electronic record file using multimedia techniques.

Storage; Storage of data in electronic format is as cheap as it is compact. By using CDs or zip disks, incredible amount of shelf space can be saved that otherwise would have been used for storing large textbooks. Data can be stored safely from physical harm and from unauthorized viewing.

Data Views; One of the special benefits of computerized records is their ability to readily display different views - for example, all current medications, or problems; the last ten full blood counts in graphic display; test results for a specified admission or date range. The data in the record are no longer static and accessible only in the order and format determined by the writer, but can be dynamically displayed in any way that suits the needs of different viewers.

Abstraction and reporting; Electronic patient follow-up systems allow automatic reporting of records which can be used for statistical analysis as well as costs of care and services provided. Data can quickly be gathered for research studies and up to the minute reports generated. All the data required for administration

and contract management can be derived automatically from the medical records. Data quality and standards; Data can be checked as they are entered to ensure adequacy and accuracy by querying entries that are unlikely or rejecting those that are impossible. Results and reports can be entered directly from other systems, eliminating the possibility of misfiling and of transcription errors.

Decision support; EMR systems are also helpful in making important clinical decisions. Knowledge-based tools can be useful in incorporating intelligent alerting flags to users warning them of possible errors and advising them on the best treatment methods. Practically, there are major advantages to the pediatrician in being able, at the press of a button, to automatically retrieve and repeat prescriptions, fill in forms accurately and automatically, complete and send discharge summaries and so on. In the article published by New Zealand Health Information Services on EMR Systems, it is stated that the advantages of EMR systems for administrators are clear in that quality data for reporting, workloads, costings and audit are readily accessible ("Electronic Medical Records").

Tangible results from use of EMR systems include: increase in patient volume, an increase in healthcare provider satisfaction, and an increase in patient satisfaction (Rogoski 12-16). With EMR, the physician can better assess his/her patients' needs, create a personalized treatment (even from a distance) and improve doctor-to-patient interaction. Return on investment for these systems are measured primarily by the elimination of medication errors, process improvement. This process improvement will then increase patient satisfaction, which will also increase return business and word of mouth advertising. On the other hand, use of EMR systems can really become a headache because of

several arguments raised against it. These arguments include things such as the need for retraining the end-users, high costs associated with installing these systems, hardware and software failures which cause a pain in the neck, and maybe more important than all that has been said, they require time that the healthcare provider does not have.

What physicians want is improved clinical procedures. Mildon and Cohen suggested that providers of EMR systems should be looking for solutions which automate the repetitive tasks in practicing medicine with tools to guide them through the regulatory and legal obstacle course that exists in medical practice without forcing serious changes in workflow (Cohen, and Mildon 15). Electronic Medical Record Systems offer pediatricians the following clinical benefits (15):

- Higher quality documentation
- Patient education
- Reminders and protocols
- Management of medications
- Signing of charts
- Callbacks and telephone triage

In terms of higher quality documentation, EMR tools ensure that each note is complete, standardize chart quality and minimize errors. Charts are legible and organized, visits are documented consistent to the level of service provided. Secondly, providers don't need to worry about a copied supply of handouts. EMR products can be used as a tool for the providers to illustrate or explain procedures or conditions to patients, printing directly from the system. Thirdly, An EMR

generates health maintenance reminders each time providers access the patient's chart. Reminders can be flagged by age, sex, diagnosis or set up individually by patient. EMRs document prescriptions into the chart automatically and assist in managing medications more effectively. Most EMR systems offer medication databases that check for interactions such as drug-to-drug and drug-allergy. Signing of charts are made easy allowing pediatricians to sign sections electronically from any workstation. This lets the pediatrician review charts at different locations and at times that are more convenient. Last but not the least electronic patient follow-up systems give staff access to the medical record which eliminates the need for the physician to locate and pull paper charts for patient information to answer questions or return patient calls. Additionally, the improved chart access is also invaluable for telephone triage personnel. There are also administrative gains to pediatricians of using patient follow-up systems as well. Mildon and Cohen listed these administrative gains as (16):

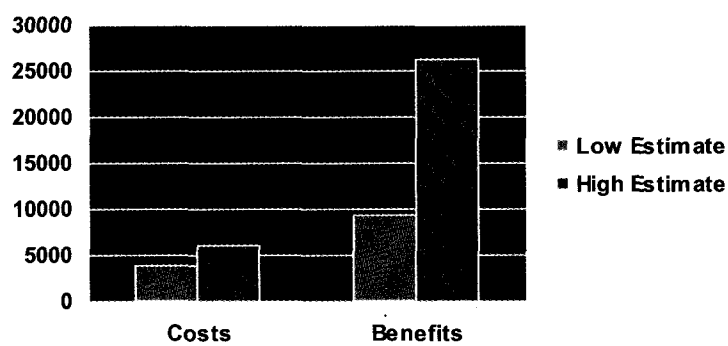
- Decreased chart pulls and less filing
- Fewer lost charts
- Improved communication
- Chart requests and audits

By using electronic patient follow-up systems, pediatrician's workstation becomes a chart drawer which gives the pediatrician access to the charts electronically instead of pulling and re-filing manually. Secondly, a common frustration for even the most efficient paper-based medical recording system is the lost chart. By having an EMR system in place, pediatricians do not have to

worry about a lost chart because these systems offer an advantage of the chart being available from any workstation. With an EMR, multiple people can view a patient's chart simultaneously, so the practice never has to worry about who has the chart. Thirdly, features such as e-mail messaging and online-chat (instant messaging) enhances communication between the pediatrician and the patient as well as between the pediatrician and other parties such as colleagues and laboratory personnel. E-mail between physicians and patients offers important opportunities for better communication. Linking patients and physicians through e-mail may increase the involvement of patients in supervising and documenting their own health care, processes that may activate patients and contribute to improved health (Mandl, Kohane, and Brandt 495-500). Mandl, Kohane and Brandt claim that as a global society, we are approaching a critical mass of internet users that will lead to a wide diffusion of electronic communications within medical practice (497). In present, internet technologies have become useful tools for medical practice. Online, physicians can search the medical literature and find both synoptic and full-text medical journal content (497). If a pediatrician receives a request for copies of medical records during audits, the chart must be located and pulled, copied, reassembled and re-filed. An EMR eliminates this process since the entire record is accessible and printable from a workstation. Auditors can be given access to a workstation to pull requested records.

When it comes to financial benefits of using electronic patient follow-up software, the rewards are satisfying. Independent research and user experience suggest that the use of EMR systems can help organizations save money and can be used as sources of new revenue (Renner 63-67). The key benefit is that it

streamlines the work-flow. The combined functions of appointment and demographic management, capturing patient-reported medical complaints, lab result and test review, prescription handling and non-urgent consults can positively impact the workflow and resource expenditure for the entire practice and simultaneously boost patient satisfaction (Ura 52-53). Most of these services are currently handled by telephone, which has two major drawbacks: dependency on synchronous communication and risking fallible documentation. On the other hand, participation in asynchronous communication, enabled by online systems, fits well into most provider and support staff routines. Pediatricians can respond to issues when it fits into their daily schedules and not simply on demand or via "phone tag." While reports suggest that patients do not expect online consults to replace all offices visits, there is an expectation of promptness--response within 24 hours. Although this expectation may be high, it is less of an additional responsibility for practitioners as a viable alternative to telephone communication already taking place daily.




Source- "The Need for Electronic Medical Records in Primary Care" American Medical Informatics Association Annual Symposium, November 12,2002.

**Figure 3.** Cost-Benefit Analysis for Implementing Pediatric EMR Software (Low and High Estimates).

Among the potential rewards of using such systems are reduced transcription costs, lower chart and storage expenses, reduced copying expenses, reduced labor costs and malpractice insurance (See Appendix A-2 for an example of net savings from implementing an EMR system). If pediatricians complete their documentation at the point of care, virtually no transcription is needed at the end of day. Reduced paperwork and saved time are important factors that need close attention, in here. Mildon and Cohen pointed out that transcription fees can be cut by $300 to $1,000 per month, per physician. Lower chart and storage expenses occur as a result of abandoning paper. Abandoning paper means abandoning expenses that support paper such as filing systems and costs for paper supplies. Mildon and Cohen estimated that costs for a paper record system are estimated at about three dollars per record. In addition, practices can eventually reclaim the space used to store and file records. They added that an EMR allows practices to print records directly from a workstation, instead of copying records in-house or using a copying service. These savings can add up considering all the requests for copies that practices receive from attorneys, insurance companies and other physicians (16). Another benefit of the electronic patient follow-up systems and perhaps the most important one, is the reduced labor costs. An EMR system with a solid foundation, decreases staff time, and labor since the record can be accessed by anyone, at any time, when information is needed. These savings translate into a reduction or redeployment of staff.

In healthcare, information systems are not a commodity that is sold to the patient. There are no billable services and therefore no direct income. The inherent benefit of an information system is indirect that it is a tool and only a

tool to improve and record patient care.

Customer satisfaction increases as a result of improved relationships with the patients. Specific value-added benefits for patients include (15):

- Increasing a patient's access to his/her personal medical records. Patients have increasingly found value in becoming more aware of personal health issues. With managed care cost pressures, patients spend less time with their doctors (physicians currently spend on average eight minutes less time with patients per visit than ten years ago). Also, with employers shifting more of the burden of healthcare costs to employees through higher out-of-pocket expenses, patients are increasingly wanting to get smart on managing their own health to avoid unnecessary trips to a doctor's office.
- Reducing costs of obtaining medical records (instead of sending large records via messenger or postal service)
- Giving physicians immediate access to patient records from any location that has access to the internet
- Ability to transfer records quickly to other doctors. This is particularly helpful when patients seek second opinions concerning serious medical problems
- More accurate physician documentation and billing will reduce errors in billing and the loss of medical files
- Internet connectivity alone allows quicker, easier communication with patients. With improved communication, patients would be able to

better manage their health. Potentially value-added services include:

- Sending automatic email messages for follow-up appointments
- Automatically communicate test results
- Quick and easy referrals to other physicians via email

The major benefit to the patient is that access to his/her health information is made much easier. Patients can have access to their medical records wherever, whenever and in whatever format they want. There are also laws which enforce physicians to inform patients on their health. According to Regulation on Patient Rights, each and every patient has a right to request an oral or a written information on his/her health, medical processes which he/she is exposed, and benefits and detrimental effects of the medical processes which he/she is exposed. More than this, every patient has a right to examine his/her medical records, to get a copy of his/her medical records, and to request a remedy on inaccurate records. For this reason, it is better for the physician to have a system in place that informs patients on their health at anytime, anywhere and in any format. As a result of these efforts, the benefit to the community turns out to be the delivery of best quality care in the most economic ways possible.

A growing number of patients are using e-mail and the World Wide Web (web) to seek information and communicate with health care providers (Mandl et al. 498). Patients have access to medical information, self-help and support groups, and even medical experts (498). The promise of e-mail in connecting physicians with the patients is inevitable, thereby increasing access to care, enhancing patient education, augmenting screening programs, and improving

adherence to treatment plans. Barriers to access often arise simply because physicians can be difficult to reach. Unlike telephone conversations, which require both parties to be available at the same time, e-mail, like voice mail, is an asynchronous mode of communication, essentially creating continuous access to the health care system (Balas et al. 152-159). Today, a widening gap is developing between the crucial need for transmitting more information and the relatively few and often brief face-to-face opportunities for communication between physicians and patients. The quality of these personal encounters is further diminished by the need for physicians to address administrative issues, such as referrals, insurance approvals, and rejected claims, during precious contact time (Mandl, Kohane, and Brandt 497). Inadequate communication, now more the rule than the exception, leads to increased stress, diminished satisfaction, decreased adherence to therapeutic regimens, and elevated risk for malpractice claims (Bertakis 217-222). Linking patients and physicians through e-mail could increase the involvement of patients in the supervision and documentation of their own health care, processes that may activate patients and contribute to improved health. A good example for an electronic linkage activating patients is an interactive computer-based system called the CHESS (Comprehensive Health Enhancement Support System), which is used to support people with AIDS and HIV infection (Gustafson et al. 605). On the other hand, there are potential pitfalls of using the internet and e-mail. Certain kinds of communication needs may be satisfied through the internet and/or by using e-mail. For instance, patients can make use of e-mail to make an appointment or they may request general information, such as a list of daily meals, diabetic foods, or specific

information, such as a modified insulin dosage based on home monitoring of glucose levels. Through the use of internet and e-mail, pediatricians might initiate e-mail contact to conduct routine guidance and education for their patients. These contacts can take the form of monthly electronic newsletters or message posts to an electronic bulletin. In contrast, the use of e-mail might be inappropriate in some cases, and face-to-face or telephone contact might be required. Use of e-mail by patients for urgent needs could lead to problems not being addressed quickly enough. It might also be inappropriate for physicians to use e-mail to communicate abnormal or confusing test results or to relay bad news. Face-to-face contacts are optimal for making many diagnoses, although elaborate telephone triage systems have been successfully used for this purpose (Poole et al. 670-679). If used properly, internet and e-mail may enhance contact between the physicians and the patients. By increasing opportunities for communication before and after visits, e-mail might help optimize the value of personal encounters. Further research is needed to develop a consensus on the guidelines to direct patients and physicians to use the contextually appropriate mode of communication. Mandl, Kenneth D; Kohane Isaac S.; and Brandt Allan M. declare that evidence-based indications and contraindications for e-mail in the medical context must be clearly specified so that e-mail is used appropriately and does not become a barrier to telephone or face-to-face contact. Still, uses of the internet and the e-mail for medical reasons are relatively limited, even as internet use globally has dramatically increased. However this use is not homogeneously distributed across the socioeconomic spectrum of all income levels (Mandl 508-511). As pediatricians begin offering internet-based services, they should first

assess the level of access to the necessary technology among populations in need. Otherwise, those patients with limited financial or computing resources may be excluded from enjoying the benefits of medicine on the web. For today, socioeconomic status, and health insurance are the main factors which determine social inequalities in health outcomes. Ultimately, as effective interventions become available via the internet, health outcomes may, in part, be determined by access to the internet (509). Such businesses as telephone companies, cable television providers, technology companies, and mass media conglomerates have identified this vast market for information as a major area for investment and development. Web-browsing technology will soon be built into standard televisions.

In a research study conducted by a group of medical doctors, growth and determinants of access in patient e-mail and internet use were investigated. The investigation had the following specific objectives: to measure the rate of access to and use of the internet and e-mail, to determine socio-demographic predictors of access, and to measure the change in internet and e-mail access over a 1-year interval (from 1998 to 1999) (510). For investigation purposes, a survey is conducted in the emergency department of a large urban academic children's hospital. The study revealed that a total of 72.8% of participants use or have access to the internet, e-mail or both, an increase from 52.2% in the 1998 survey (510). There is a computer or some type of Internet connection at home for 58.9% of respondents, and all but 1.6% of them have a telephone at home. In the 1999 cohort, 48.5% of respondents regularly use the Internet or e-mail, compared with 43.1% in 1998 (510). Outside the home, 58.8% have access to

the Web or e-mail, with 41.1% having access at school or work. Internet and email access from outside the home is primarily at work (52.2%), schools (8.9%), friends' and relatives' houses (16.7%), and public libraries (11.5%). In 90.5% of households with a computer or some type of Internet connection, other members of the family, besides the respondent, also use the computer. Of respondents with no computer at home, 26.1% intend to buy one within the next 6 months.

The study findings on the patient attitudes toward internet-based services revealed that more than half (56.5%) of respondents indicated that they would be interested in using the Internet or e-mail to receive follow-up information about their child after an emergency department visit, and those with Internet or e-mail access were much more likely to be interested (511). Of those who were not interested in receiving such services, their most commonly expressed concerns were (1) "other people that I know might see my test results (6.5%), (3) "I do not have access to the Internet or to e-mail" (53.8%), (4) "the system might not be reliable" (1.1%), (5) "the system would not be convenient for me" (1.1%), and (6) "I want my primary care provider to be informed of the communication" (2.2%).

Strikingly, the results are very optimistic in the sense of approving that internet-based services are becoming popular among patients. There is a dramatic increase in the internet or e-mail access of patients as the time goes on. Despite overall increasing access, many of the economically disenfranchised remain disconnected. But this may change. Computer prices are decreasing, putting them in reach of a growing number of people. Affordable set-top boxes

that allow e-mail and Internet access using a standard television, and powerful inexpensive personal computers, are now readily available. Even standard television sets will soon have Web browsing capabilities. Penetration of this technology into the home will likely parallel that of color television sets, found in 97% of American homes. In addition, if effective health care interventions are being provided via the Internet, then provision of equipment or Internet service to the shrinking minority of patients without access may be cost-efficient and feasible. It had been observed that rates of access exceeded rates of use. Numerically, about two thirds of those patients surveyed actually used internet and e-mail. The availability of web-based health care applications may motivate others to go online.

This trend observed in the U.S.A., is very likely to be adopted in other countries which can be identified as the followers. There is no doubt that early adopters will have an advantage over the others in the long-run. If to put in practice, e-mail or web-based health communication may become more practical than conventional patient-physician encounters.

## 1.3 Summary of the Developed Web-based Model

### 1.3.1 Planning Stage

During the planning phase, the first thing to do was identifying the scope of the project. In determining the scope of the project, one-on-one interviews with the specialists and some benchmarking were necessary. All of the participating pediatricians were very interested in sharing their ideas on the scope of the project. To start up with the project, data was gathered on what the function of the system would be, to whom the system would serve, and in which platform the system would be useful. System inputs and outputs were identified after a thorough research on similar software available in the marketplace and on the internet as well as from the ideas generated during interviews with the pediatricians.

First of all, the system should allow its users to exchange medical information between each other regardless of place, time and format. Secondly, the system should serve both the pediatrician, the patient and the laboratories that the pediatrician is in close contact. On the pediatrician's side, the system should allow the specialist to edit, to update and to delete patient's personal and medical information, to store patient's immunization calendar and laboratory test results. Additionally, the system should allow the pediatrician to transfer updated information from the local server to the internet server, to view daily/weekly appointments and to chat with his/her patients' parents and colleagues. On the patient's side, the system should allow the patient/patient's parents to reach patient's up to date medical record history involving immunization calendar and

growth curve. In addition, the system should allow the patient/patient's parents to send X-ray, CT, MR, and EEG results electronically and to look up medical and general information on childrens health and diseases via using the website. On the laboratories' side, the system should allow laboratories to submit various test results belonging to patients via internet. The system should allow the pediatricians to run the model both locally and on the internet environment. Thus, the platform which the system would be implemented should serve both purposes. In deciding what the system inputs would be, work-flow in a pediatrician's private office setting, reports and other paper-based procedures were examined. After an assessment of these factors, system inputs were identified as follows:

On the pediatrician's side:

- Patient's personal information including patient's name and surname, birthdate, gender, blood type, family background, allergies, his/her reactions for drugs, social security, contact and birth information.
- Information on patient's medical history including control findings and prescribed medicines, growth data (height, weight and head circumference) and curves, normal percentile values at a given date.
- Patient's immunization calendar data including which vaccinations are needed, vaccination doses and dates, and vaccination timeline.
- Information on medication, diseases and chidren care. Guidelines on how to approach childrens diseases before placing a call to the doctor's

office. Answers for frequently asked questions and monthly electronic newsletters for informing patients on childrens health and diseases.

On the patient's side:

- Patient's X-ray, MR, CT and EEG results (if available) in a digital format.

On the laboratories' side:

- Information on patient's laboratory test results such as blood test, antibiogram test, routine urinary test, blood ions test, peripheric scattering test, Feces test, liver function and other test results.

System outputs were determined as follows:

For the pediatrician, the outputs needed were:

- A condensed report on the patient's personal and medical information
- A detailed report on the patient's immunization calendar on which the specialist can track patient's vaccination timeline and doses
- A detailed report on the patient's laboratory test results
- A detailed graphical representation of X-ray, MR, CT and EEG results.

For the patient, the outputs needed were:

- A condensed report on his/her immunization schedule
- A detailed report indicating his/her growth values for each control date.
- A detailed report on prescribed medicines if it becomes a necessity.
- White papers on the treatment of childhood diseases and childrens fitness and wellness

- A printable recommended immunization schedule
- Print outs on answers for frequently asked questions and downloadable documents on childrens nutrition and health
- Printable and downloadable electronic newsletters

For the laboratories, the outputs needed were:

- Printable and downloadable submission forms for laboratory test results
- A confirmation report on submitted laboratory test results

### 1.3.2. Analysis Stage

In the analysis phase, requirements for the system were gathered. Requirements gathering process was all about collecting information based on the steps taken during the planning stage. During this stage, ideas generated on how the system should function, benchmark with similar software, data on specific outputs such as reports, forms and a thorough analysis of existing systems and procedures were vital factors which would affect the outcome of the project. Documents such as growth curve values and percentiles for children, laboratory test forms, guide books on children health and safety, school reports, white papers on medication and drug dosage, published books by pediatricians on children health and diseases as well as reports on immunization scheduling were analyzed. Brainstorming and creative thinking exercises were extremely effective techniques used during this stage. As a result of brainstorming exercises, the following ideas were generated on how the system should function:

- The system should involve three types of end-users: the pediatrician, the patient and the laboratories that the pediatrician has close contact with
- It should allow end-users (pediatrician, patient and laboratories) to exchange information simultaneously on any issue related to children's health and wellness
- It should allow each type of user to login to the system and exchange information within the system as secure as possible
- It should allow easy navigation across different zones
- It should contain data on the practicing pediatrician's personal background as well as work history
- It should be placed on the internet for ease of use and cost-effectiveness
- It should include private and public information
- It should stand as an example for all pediatricians working privately
- It should contain all the capabilities of ordinary pediatric software such as being able to track patient personal and parental data, patient's growth, immunization, and laboratory data
- It should contain features such as file transfer between the local and the internet server
- It should contain an appointment table on which the pediatrician and patient parents can track appointments and check-up/control dates
- It should allow data back-ups
- It should contain an online-chatting facility between the end-users
- It should allow the pediatrician to send mobile phone messages (SMS) to

his/her patients' parents

- It should allow the pediatrician to send electronic greeting cards to his/her patients' parents over the internet
- It should allow the pediatrician to reach patient data from anywhere, anytime and in any format with the help of a personal computer
- It should allow the patient parents to track patient immunization schedule and growth related data from anywhere, anytime and in any format with the help of a personal computer
- It should allow patient parents to send X-ray, MR, CT and EEG results in digital format over the internet
- It should allow electronic data transfer between the practicing pediatrician and the laboratories that the particular pediatrician is in close contact with.
- It should indicate information on the frequently prescribed drug names and doses classified according to children diseases
- It should involve a topic center in which patient parents can find useful information about the latest news and trends in children's health and growth through links
- It should contain multimedia instructions for patient parents on how to treat certain types of children's diseases at home
- It should contain a part in which the patient parents can create a recommended immunization schedule
- It should indicate information and involve links to popular pharmaceutical firm websites

- It should allow access to information on infant care and nutrition

Similar software used for benchmarking reasons included the ones obtained from the pediatricians surveyed and a few from the internet. Some of the pediatricians were more than willing to lend copies of the software that they were currently using for their daily practices. These software can be listed as follows:

- MirandaSoft
- MedikoSoft
- MaviKlinik
- MedicineSoft
- Eurogrowth

By taking a closer look on the listed software, common processes were tried to be picked out. It was found out that all the software listed in here made use of a general database in which basic information about the patients and his/her family was kept. In this database, patient's medical information was also kept. Another common point of use was a module in which growth related data such as height, weight and head circumference measurements were kept. Among them, MirandaSoft, MedikoSoft, MaviKlinik and MedicineSoft had modules specifically for keeping patient's laboratory test results whereas Eurogrowth did not. Only, MaviKlinik had a module in which a list of drugs and related information could be found for prescription reasons. MirandaSoft was rich in terms of finding out information on vaccine and diagnosis definitions. MaviKlinik and MirandaSoft were the only software applications which were distinguished from the others by

their capability for online integration. Eurogrowth's strength was its capability to detail growth data by calculating z-scores and growth velocities. As listed in here, the advantages were many varying from software to another. On the other hand, the most important limitation of these software was their design for local use only. Surely, this was the potential disadvantage on which the idea of developing the proposed web-based model had stemmed from. MedikoSoft was the only DOS-based software application whereas all the others were written for WINDOWS operating system. Because MedikoSoft was written for DOS, the modules included were not very user-friendly. Within different modules, all the work was coordinated with the help of the keyboard. For simplicity reasons, it was important for the software to have mouse-controlled input such as drop-down and list boxes where the end-user enters values for certain fields by the click of a mouse.

### 1.3.3. Design Stage

Design phase involved two sub-stages which were logical and physical design. Logical design of the system included process modeling, data modeling and logic modeling sub-stages. Physical modeling included processes such as normalization and report and interface design.

Upon the completion of all the steps listed within the system development life cycle, a final product named PEDI-NET© was developed. This end-product was the web-based patient follow-up model, which was proposed to the pediatricians for use in their private practices. The main purpose for developing

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© Copyright. The software is available from the author upon request.

the web-based model is to interact with patient parents in real time regardless of location and format. By making use of PEDI-NET© software, pediatricians can inform their patients through the world wide web, send them the latest information and trends for children healthcare and diseases. The web-based patient follow-up software has a quiet user-friendly interface which make it easier for both the pediatrician and the patient to obtain information.

## 1.4 Research Overview

The primary purpose of this research is to examine if the the proportion of the pediatricians who would be willing to adopt the proposed web-based model is equal to 50% ($H_0 : \pi = 50\%$) or if it is higher than 50% ($H_1 : \pi > 50\%$) of the entire population. First, a demo version of the web-based model for a patient follow-up software is designed for to be used during pediatrician visits. Prelimenary design includes the basic interfaces which are used in a typical pediatric EMR such as: a module for keeping patient's personal and family information, a module for keeping patient's medical history, a module for keeping patient's immunization data and a module for keeping patient's laboratory test results on the specialist's side; a module for patient's growth data and immunization calendar on the patient's side; modules for submitting medical test results on the laboratory's side. In order to test which hypothesis holds true, an investigation is made on the use of electronic patient follow-up (EMR) software by pediatricians in İzmir metropolitan area. One-on-one interviews are held with the participating pediatricians in a hospital or a private office setting. During the interviews, an abstract demonstration of the web-based model followed by a structured questionnaire is presented. The demonstration of the web-based patient follow-up model includes guidelines on the features of the software and how to use it. Following the software demonstration, an online questionnaire is conducted on each participating pediatrician. The questionnaire involves both open and close-ended questions on the personal and occupational data, whether or not these specialists use electronic patient follow-up software, for what reason the software is utilized, advantages of using such software, what can be done in

terms of enhancing the capability of such software and whether they would make use of the web-based model or not. In order to make things easier, computer-based patient follow-up software usage habit of the pediatricians is questioned as a means of post-stratification before the interviews are held. Telephone calls are made with the pediatricians to learn if they are making use of computer-based patient follow-up software in their office or not. Interviews are planned by keeping the proportions of those pediatricians who make use of a software and those who do not as equal as possible. The main reason behind one-on-one interviewing is to establish personal contact and to make an investigation on the software that they use. A close watch on the patient follow-up software is necessary to find out common points of use. To test whether the percentage of those pediatricians who would be willing to adopt the proposed web-based model is equal to 50% of the entire population or more, parametric z-test is used.

*Chapter 2*

# METHOD

## 2.1 Subjects and Data Collection Procedures

For data collection reasons, a cross-sectional cohort study is chosen. Questionnaires are administered during one-on-one interviews by the interviewer along with a brief oral description explaining the purpose of the study (See Appendix B-1 and B-2). All participation is voluntary and responses are made regarding the criteria specified on the questionnaire. Total respondents were 61 pediatricians (n=61). All of the pediatricians involved in the study are members of İzmir Chamber of Physicians and are either working on their own and/or affiliates of public or private health care institutions. They all have earned their M.D. degrees at least in the field of Pediatrics and its related majors and have met all of the requirements needed to receive their titles. Overall, 44,26% of the respondents are female whereas males make up 55,74% of the entire sample.

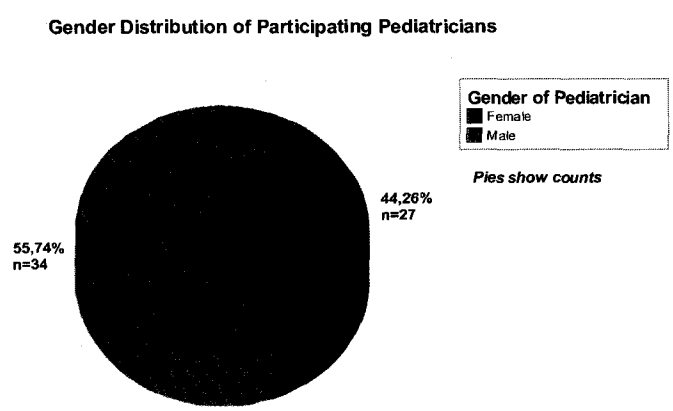



**Figure 4.** Gender Distribution of Surveyed Pediatricians.

Among the sample charactereristics, pediatricians' medical school of specialization is one of the most significant parameters for profiling reasons. Statistical findings show that 3 of the participating pediatricians acquired their specialization from Ankara University Faculty of Medicine, Department of Pediatrics, 1 from Dokuz Eylül University Faculty of Medicine, Department of Pediatrics, 22 of them from Dr. Behçet Uz Childrens' Hospital, 21 of them from Ege University Faculty of Medicine, Department of Pediatrics, 8 of them from Hacettepe University Faculty of Medicine, Department of Pediatrics, 1 of them from İstanbul Göztepe Public Hospital, Department of Pediatrics, 1 of them from İstanbul Haseki Hospital, Department of Pediatrics, 1 of them from Sami Ulus Childrens' Hospital, 1 of them from SSK Bakırköy Doğumevi Childrens' Hospital, and 2 of them from SSK Tepecik Training Hospital. The frequencies and the corresponding percentages for the pediatricians' medical school of specialization are given in Table 7 and on Figure 36.

| | Freq. | Percent | Valid Percent |
|---|---|---|---|
| Ankara Üniversitesi Tıp Fakültesi Çocuk Sağlığı ve Hastalıkları A.B.D. | 3 | 4,9 | 4,9 |
| Dokuz Eylül Üniversitesi Tıp Fakültesi Çocuk Saglığı ve Hastalıkları A.B.D | 1 | 1,6 | 1,6 |
| Dr. Behcet Uz Çocuk Sağlığı ve Hastalıkları Hastanesi | 22 | 36,1 | 36,1 |
| Ege Üniversitesi Tıp Fakültesi Çocuk Sağlığı ve Hastalıkları A.B.D. | 21 | 34,4 | 34,4 |
| Hacettepe Üniversitesi Tıp Fakültesi Çocuk Sağlığı ve Hastalıkları A.B.D. | 8 | 13,1 | 13,1 |
| Istanbul Göztepe SSK Hastanesi Çocuk Sağlığı ve Hastalıkları A.B.D. | 1 | 1,6 | 1,6 |
| Istanbul Haseki Çocuk Sağlığı ve Hastalıkları Hastanesi | 1 | 1,6 | 1,6 |
| Sami Ulus Çocuk Sağlığı ve Hastalıkları Hastanesi | 1 | 1,6 | 1,6 |
| SSK Bakırköy Doğumevi Çocuk Hastanesi | 1 | 1,6 | 1,6 |
| SSK Tepecik Eğitim Hastanesi | 2 | 3,3 | 3,3 |
| Total | 61 | 100,0 | 100,0 |

**Table 7.** Medical School of Specialization.

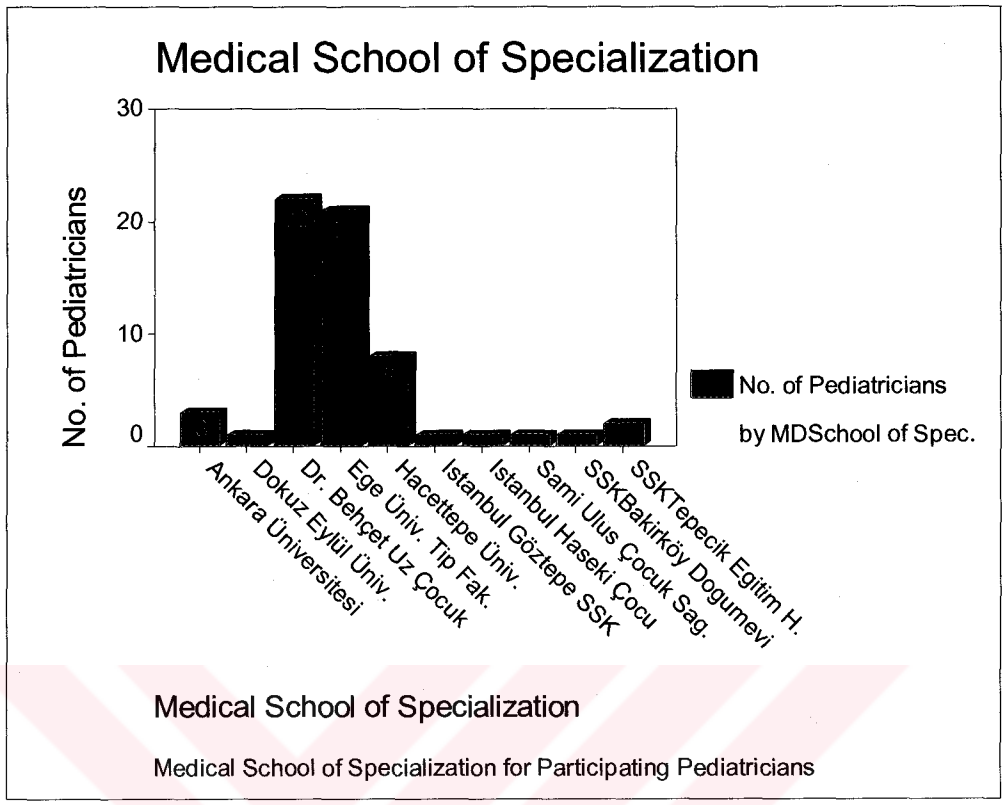



**Figure 5.** Medical School of Specialization for Surveyed Pediatricians.

Survey results show that most of the participating pediatricians are specialized in only one field whereas the rest holds dual degrees. 34 of 61 pediatricians are specialized only in the field of General Pediatrics. Within the rest of the sample, 1 of them is specialized both in the fields of General Pediatrics and Pediatric Newborn, 3 of them in the fields of General Pediatrics and Pediatric Allergy, 2 of them in the fields of General Pediatrics and Pediatric Cardiology, 1 of them in the fields of General Pediatrics and Pediatric Endocrinology, 1 of them in the fields of General Pediatrics and Pediatric Genetics, 1 of them in the fields of General Pediatrics and Pediatric Hematology, 2 of them in the fields of General Pediatrics and Pediatric Infectious Diseases, 1 in the fields of General Pediatrics and Pediatric Neontology, 3 in the fields of Pediatrics and Pediatric

Nephrology, 5 of them in the fields of General Pediatrics and Pediatric Neurology, 2 of them in the fields of General Pediatrics and Pediatric Oncology, 1 in the fields of General Pediatrics and Pediatric Premature, 1 in the fields of General Pediatrics and Pediatric Romatology, 1 in the fields of General Pediatrics, Pediatric Gastroenterology and Hepatology and 1 in the fields of General Pediatrics, Pediatric Genetics and Infectious Diseases.

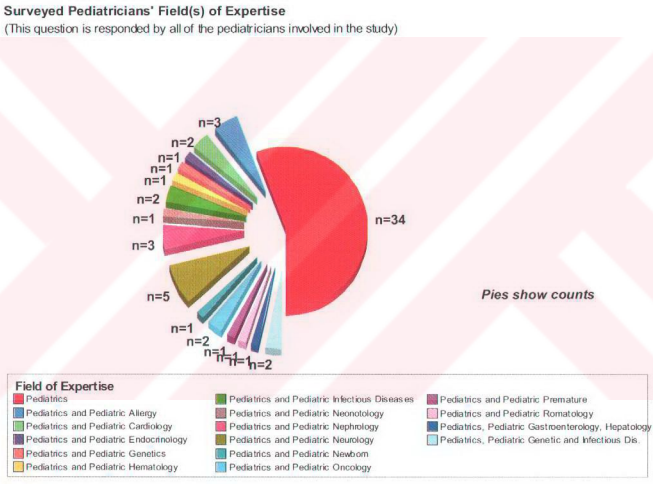



**Figure 6.** Participating Pediatricians' Field(s) of Expertise.

The method of selection employed during the research is stratified probability sampling. In order to apply this technique, the overall population is stratified into districts of İzmir province according to their distribution of income (GDP), size of their population, and the number of healthcare units in each district. The strata (distinct groups) are chosen from those districts which would

best represent İzmir metropolitan area. The number of pediatricians selected from each stratum (district) is proportional to the size of the stratum.

| | Frequency | Percent | Valid Percent |
|---|---|---|---|
| Bornova | 12 | 19,7 | 19,7 |
| Buca | 7 | 11,5 | 11,5 |
| Karsiyaka | 12 | 19,7 | 19,7 |
| Konak | 25 | 41,0 | 41,0 |
| Narlıdere | 5 | 8,2 | 8,2 |
| Total | 61 | 100,0 | 100,0 |

**Table 8.** District of Private Office

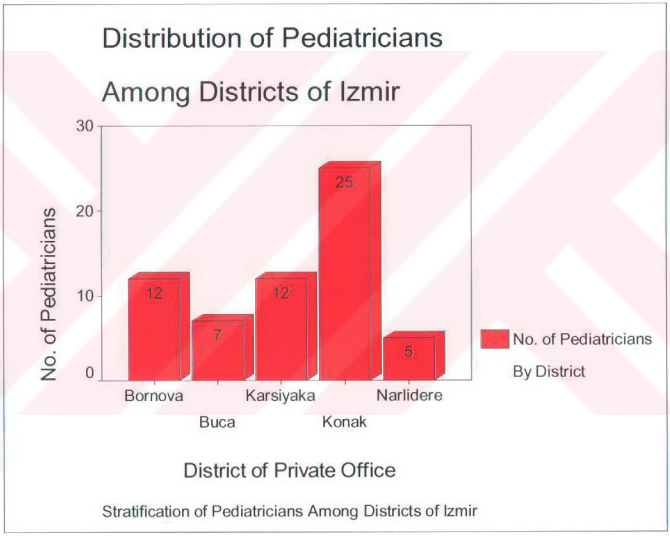



**Figure 7.** Stratified Distribution of Pediatricians Among Districts of İzmir.

## 2.2 Questionnaire Measures

*Willingness to Adopt Web-based (Internet-based) Patient Follow-up Software.* All of the respondents are asked if they would be willing to make use of the proposed web-based model for patient medical record keeping in their daily practices.

*Computer-based Patient Follow-up Software (EMR) Use.* Pediatricians' use of computer-based patient follow-up software is assessed using the results obtained from the questionnaire conducted. Pediatricians are questioned if they are making use of an EMR software or not. Those who answer "YES" are labeled as Type A whereas those who answer "NO" are labeled as Type B. The content and the statistical measures attained from the survey are reported in the following section.

*Computer-based Patient Follow-up Software (EMR) Experiences.* Several computer-based patient follow-up software experience measures are taken. Specifically, the questionnaire assesses respondents' perceptions of the extent to which the EMR software is used for, advantages of using such software, what can be done in terms of enhancing the capability of such software as well as EMR specific questions.

*Independent Variables.* The null hypothesis assumes that the population percentage of pediatricians who would be willing to make use of the proposed web-based model is equal to 50% of the entire population. Accordingly, the independent variable turns out to be the willingness to adopt the proposed web-based model. Building on this idea, the alternative hypotheses is formed as an argument.

## 2.3 Results and Discussion

In this study, the assumption that the proportion of pediatricians who would be willing to adopt the proposed web-based model is equal 50% of the entire population, is tested against the assumption that the proportion of the pediatricians who would be willing to adopt the proposed web-based model is higher than 50% of the entire population. Other related issues addressed are EMR software specific points and respondents' perceptions of the extent to which the EMR software is used for, advantages of using such software, what can be done in terms of enhancing the capability of such software. Descriptive statistics and non-parametric tests for all study variables are reported in the following section. Analysis dealing with the null and the alternative hypotheses is discussed next.

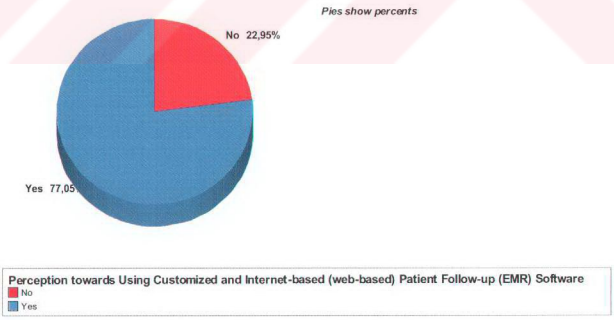



**Figure 8.** Willingness to Adopt Web-based (Internet-based) Patient Follow-up Software Among Surveyed Pediatricians.

Overall, the proportion of those pediatricians who are willing to adopt the proposed web-based pediatric patient follow-up software (77,05%) is found out to be greater than the proportion of those pediatricians who are not willing to adopt the proposed web-based model (22,95%) (See Figure 8). This result is an evidence that the proposed web-based model is attractive to adopt for the majority (77,05%) of the respondents for their private practices. In order to test which hypothesis holds the truth a one-sided test for a population percentage is applied to the survey results. The first step was to find out the z-value: z-value is calculated by taking the difference between the proportion of those pediatricians who would be willing to adopt the web-based model and the hypothesized proportion and then dividing this difference by the square root of hypothesized proportion multiplied by its difference from 100 and divided into the sample size. Accordingly, the proportion of those pediatricians who would be willing to adopt the software is found out to be 77% of the entire sample. Then the difference between 77% and 50% is taken and divided by the square root of 50% times itself and divided into 61. The z-value turns out to be 4,22. The formula used for finding the z-value under the null hypothesis and related calculations are provided in the following table.

| | |
|---|---|
| $z =$ | $(p-\pi)/\sqrt{((\pi(100-\pi))/n)}$ |
| $z =$ | $(77-50)/\sqrt{((50(100-50))/61)}$ |
| $z =$ | 4,22 |

**Table 9.** Calculation of z-value for Assumption I.

After calculating the z-value, the critical values corresponding the significance levels of 1% and 5% are found from the normal distribution table. These critical values are +2,33 and +1,65 respectively since we are testing if the proportion is greater than 50%. The calculated z-value turns out to be greater than 2,33 and 1,65 which means that the null hypothesis can be rejected both at the 1% and 5% significance levels. Thus, it should be expected that the proportion of those pediatricians who would be willing to adopt the proposed web-based model is greater than 50% of the entire population ($H_1 : \pi > 50\%$) which supports the alternative hypothesis brought up as an argument against the null hypothesis.

The reason behind why alternative hypothesis holds the truth can be attributed to factors such as the attractiveness of the developed web-based model, need for speed in this competition-driven information era, how highly convinced pediatricians are by the demonstration of the proposed web-based model. Additionally, increasing technology awareness among communities and the need for efficiency and cost-effectiveness among surveyed pediatricians might be the other factors that have an impact on this outcome. However, further research has to be done in order to prove if each of these listed factors could have really affected the outcome for the first assumption.

Secondly, the assumption that the proportion of pediatricians who are currently making use of an electronic medical record keeping software in their offices (who are so called Type A pediatricians) and willing to adopt the proposed web-based model is equal to the proportion of pediatricians who are not using electronic medical record keeping software (Type B pediatricians) but willing to adopt the proposed web-based model, is tested against the assumption that the

proportion of the first type of pediatricians is higher than the proportion of the second type of pediatricians. In order to test the validity of these assumptions, a chi-square test and a one sided test for a difference in population percentage are applied on the survey results.

| | | | Perception towards Using Customized and Internet-based (web-based) Patient Follow-up (EMR) Software | | Total |
|---|---|---|---|---|---|
| | | | No | Yes | |
| Making Use of an EMR or Not | No | Count | 4 | 28 | 32 |
| | | Expected Count | 7,3 | 24,7 | 32,0 |
| | | % within Making Use of an EMR Software or Not | 12,5% | 87,5% | 100,0% |
| | | % within Perception towards Using Customized and Internet-based (web-based) Patient Follow-up (EMR) Software | 28,6% | 59,6% | 52,5% |
| | | % of Total | 6,6% | 45,9% | 52,5% |
| | Yes | Count | 10 | 19 | 29 |
| | | Expected Count | 6,7 | 22,3 | 29,0 |
| | | % within Making Use of an EMR Software or Not | 34,5% | 65,5% | 100,0% |
| | | % within Perception towards Using Customized and Internet-based (web-based) Patient Follow-up (EMR) Software | 71,4% | 40,4% | 47,5% |
| | | % of Total | 16,4% | 31,1% | 47,5% |
| Total | | Count | 14 | 47 | 61 |
| | | Expected Count | 14,0 | 47,0 | 61,0 |
| | | % within Making Use of an EMR Software or Not | 23,0% | 77,0% | 100,0% |
| | | % within Perception towards Using Customized and Internet-based (web-based) Patient Follow-up (EMR) Software | 100,0% | 100,0% | 100,0% |
| | | % of Total | 23,0% | 77,0% | 100,0% |

**Table 10.** Crosstabulational Statistics on Making Use of an EMR Software or Not in reference to Perception towards Using Customized and Internet-based (web-based) Patient Follow-up (EMR) Software.

**Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 4,157 | 1 | ,041 | | |
| Continuity Correction | 3,007 | 1 | ,083 | | |
| Likelihood Ratio | 4,243 | 1 | ,039 | | |
| Fisher's Exact Test | | | | ,066 | ,041 |
| Linear-by-Linear Association | 4,089 | 1 | ,043 | | |
| N of Valid Cases | 61 | | | | |

**Table 11.** Chi-Square Tests

**a.** Computed only for a 2x2 table

**b.** 0 cells (,0%) have expected count less than 5. The minimum expected count is 6,66.

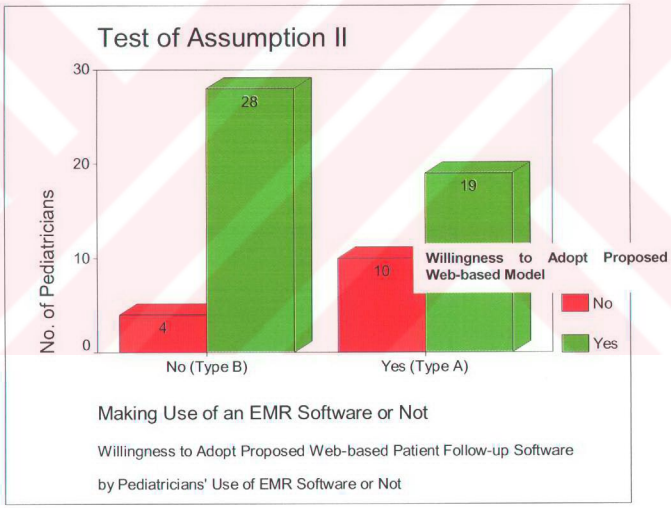



**Figure 9.** Test of Assumption II.

The hypotheses are formed to test whether if there is an association between current EMR use and willingness to adopt the proposed web-based model or not. Accordingly, the null hypothesis is stated as there is no association between current EMR use and willingness to adopt the proposed web-based

model whereas the alternative hypothesis is formed upon the idea that there is an association between current EMR use and willingness to adopt the proposed web-based model.

In order to test the validity of the hypotheses, a crosstabulation of data collected on the use of an EMR software in reference to willingness to adopt proposed web-based patient follow-up software is made. Crosstabulation results indicate that a total of 4 pediatricians out of 32 Type B pediatricians respond as 'NO' for the question on willingness to adopt the proposed web-based (internet-based) model whereas the remaining 28 respond as 'YES' for the same question. On the other hand, a total of 10 pediatricians out of 29 Type A pediatricians respond as 'NO' for the question on willingness to adopt the proposed web-based (internet-based) model whereas the remaining 19 respond as 'YES' for the same question. In aggregate figures, 14 pediatricians out of 61 give negative response in terms of willingness to adopt the prposed web-based model whereas the remaining 47 give positive response on the same issue. The next step is to apply the chi-square test on the crosstabulated data. To calculate the test statistic, expected value of each answer type is deducted from the observed value of each answer type and the difference between them is squared and divided by the expected value of each answer type which is then added up all together. The same procedure is applied for each cell on the crosstabulation table. Accordingly, the expected value of those pediatricians who are currently making use of an EMR software and willing to adopt the proposed web-based model, calculated as 22,34, is subtracted from the observed value of the same type of pediatricians which is found out to be 19. Then, the difference is squared and divided by the

expected value which turned out to be 0,5. Secondly, the expected value of those pediatricians who are currently making use of an EMR software but unwilling to adopt the proposed web-based model, calculated as 6,7, is subtracted from the observed value of the same type of pediatricians which is found out to be 10. Then, the difference is squared and divided by the expected value which turned out to be 1,7. Thirdly, the expected value of those pediatricians who are not currently making use of an EMR software but willing to adopt the proposed web-based model, calculated as 24,7, is deducted from the observed value of the same type of pediatricians which is found out to be 28. Then, the difference is squared and divided by the expected value which turned out to be 0,5. Finally, the expected value of those pediatricians who are not currently making use of an EMR software and unwilling to adopt the proposed web-based model, calculated as 7,3, is deducted from the observed value of the same type of pediatricians which is found out to be 4. Then, the difference is squared and divided by the expected value which turned out to be 1,5. Final results found are all added up together to give the chi-square ($\chi^2$) value of 4,2. In this case, degrees of freedom for the given crosstabulation is calculated as 1 ([(2-1)*(2-1)]) since the data set involves 2 rows and 2 columns. Referring to chi-square critical values table, critical value for the given degrees of freedom at the 5% significance level is found out to be 3,84 which is substantially smaller than the calculated chi-square value of 4,2. Therefore the null hypothesis could be rejected at the 5% significance level ($\alpha$ <0,05).

A second test carried out on the crosstabulation findings for determining the type of association between EMR use and willingness to adopt the proposed

web-based model is the one-sided test for a difference in population percentage. In order to test the difference in population percentages, z-value is calculated by taking the difference between population percentages and then dividing the calculated difference by the square root of each population percentage multiplied by its difference from 100, divided by each sample size and added together. Accordingly, those pediatricians who are currently making use of a pediatric EMR software (Type-A) are considered as the first sample and those pediatricians who are not currently making use of a pediatric EMR software (Type-B) are considered as the second sample. The next step is to find out the proportion of those pediatricians who are currently using a pediatric EMR software and at the same time willing to adopt the proposed web-based model within the Type A pediatricians. This proportion is calculated as 0,66. Similarly, the proportion of those pediatricians who are not currently using a pediatric EMR software but willing to adopt the proposed web-based model within Type B pediatricians is calculated. And this number turned out to be 0,88. Then, the difference between these proportions is divided by the square root of each proportion multiplied by its difference from 100, divided by their corresponding sample sizes added together. The formula used for finding the z-value and related calculations are provided in the following table.

| | |
|---|---|
| $z =$ | $(p_A - p_B) / \sqrt{[(\pi_A (100 - \pi_A)/n_A + (\pi_B (100 - \pi_B)/n_B]}$ |
| $z =$ | $(0{,}66 - 0{,}88) / \sqrt{[(66 (100 - 66)/29 + (88 (100 - 88)/32]}$ |
| $z =$ | $- 2{,}0764$ |

**Table 12.** Calculation of z-value for Assumption II.

After calculating the z-value, the critical values corresponding the significance levels of 1% and 5% are found from the normal distribution table. These critical values are -2,33 and -1,65 respectively. Since the calculated z-value is less than -1,65, the null hypothesis can be rejected at the 5% significance level. However, calculated z-value turned out to be greater than -2,33 which means that the null hypothesis cannot be rejected at the 1% significance level. Thus, it should be expected that the proportion of those pediatricians who are currently making use of a pediatric EMR software and willing to adopt the proposed web-based model is not greater than the proportion of those pediatricians who are not currently making use of a pediatric EMR software and willing to adopt the proposed web-based model ($H_0 : \pi_A = \pi_B$ or $\pi_A <= \pi_B$) at the 1% significance level ($\alpha$ <0,01). It appears that negative association between EMR use and willingness to adopt the proposed web-based model is more strongly emphasized at the 5% significance level ($\alpha$ <0,05). Figure 10 shows a graphical representation of power analyses for the both assumptions. It demonstrates changes in the power of the test as the difference in population percentages increases regarding the probability of making a Type II error.

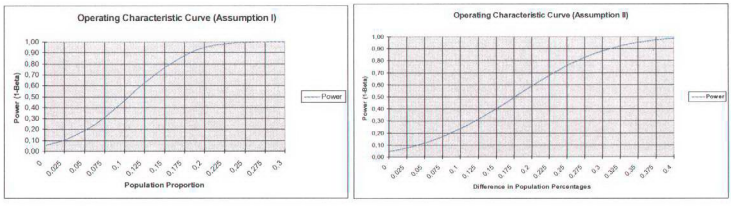



**Figure 10.** Power Analyses for Assumption I and II.

The reason behind existing negative association can be attributed to the difference in switching costs for Type A and Type B pediatricians. For Type A pediatricians, one switching cost between an EMR that is already in use and the newly developed software might be that these pediatricians find it difficult to leave their old habits aside and accept the proposed web-based model in the short-run. Underlying factors affecting their decision might be the extra money that they have to spend on the software and training. They have already made their investment and they were satisfied with their current EMR systems. On the other hand, extra time spent on transfering patient records from a paper-based catalog system to an electronic format would be the most important switching cost for those pediatricians who are not using an EMR software at all. In addition, extra money which would be spent on the hardware and software in installing the system could be shown as other switching costs affecting the decision of Type B pediatricians. Despite the disadvantages associated with switching from paper-based record keeping to electronic medical record keeping system, Type B pediatricians were found out to be more willing to adopt the web-based model. This result can be attributed to Type B pediatricians' willingness to start up with the best possible EMR solution which is made available to them.

The other factor which could affect this outcome might be the difference in internet use habits of patients living in districts chosen for study purposes. However, further research has to be done in order to prove if there is such relationship exist. Other factors affecting the outcome might be the difference in how convinced each type of pediatricians are by the demonstration of the proposed web-based model and the need for speed in this competition-driven

information era. Additionally, the difference in pediatricians' perceptions towards technical and ethical issues involved in using the proposed web-based model could have an impact on this outcome.

Investigation findings suggest that the proportion of pediatric EMR usage is the highest among pediatricians who have been holding a degree for 0 to 1 year (100%), with the result being invalid. The reason why this result should be ignored is that the distribution of pediatricians is not homogeneous for each category (classification parameter is the number of years which the specialist has been holding the degree). For the survey conducted, following results are obtained by cross-tabulating variables of number of years being a pediatrician versus pediatricians' use of a pediatric EMR software:

| | | | Making Use of an EMR Software or Not | | Total |
|---|---|---|---|---|---|
| | | | No | Yes | |
| No. of Years Being a Pediatrician | 0-1 year | Count | 0 | 1 | 1 |
| | | Expected Count | ,5 | ,5 | 1,0 |
| | | % within No. of Years Being a Pediatrician | ,0% | 100,0% | 100,0% |
| | | % within Making Use of an EMR Software or Not | ,0% | 3,4% | 1,6% |
| | | % of Total | ,0% | 1,6% | 1,6% |
| | 1-3 years | Count | 1 | 0 | 1 |
| | | Expected Count | ,5 | ,5 | 1,0 |
| | | % within No. of Years Being a Pediatrician | 100,0% | ,0% | 100,0% |
| | | % within Making Use of an EMR Software or Not | 3,1% | ,0% | 1,6% |
| | | % of Total | 1,6% | ,0% | 1,6% |
| | 3-6 years | Count | 1 | 3 | 4 |
| | | Expected Count | 2,1 | 1,9 | 4,0 |
| | | % within No. of Years Being a Pediatrician | 25,0% | 75,0% | 100,0% |
| | | % within Making Use of an EMR Software or Not | 3,1% | 10,3% | 6,6% |
| | | % of Total | 1,6% | 4,9% | 6,6% |
| | 6-9 years | Count | 3 | 1 | 4 |
| | | Expected Count | 2,1 | 1,9 | 4,0 |
| | | % within No. of Years Being a Pediatrician | 75,0% | 25,0% | 100,0% |
| | | % within Making Use of an EMR Software or Not | 9,4% | 3,4% | 6,6% |
| | | % of Total | 4,9% | 1,6% | 6,6% |
| | 9-12 years | Count | 3 | 4 | 7 |
| | | Expected Count | 3,7 | 3,3 | 7,0 |
| | | % within No. of Years Being a Pediatrician | 42,9% | 57,1% | 100,0% |
| | | % within Making Use of an EMR Software or Not | 9,4% | 13,8% | 11,5% |
| | | % of Total | 4,9% | 6,6% | 11,5% |
| | 12-15 years | Count | 7 | 6 | 13 |
| | | Expected Count | 6,8 | 6,2 | 13,0 |
| | | % within No. of Years Being a Pediatrician | 53,8% | 46,2% | 100,0% |
| | | % within Making Use of an EMR Software or Not | 21,9% | 20,7% | 21,3% |
| | | % of Total | 11,5% | 9,8% | 21,3% |
| | More than all of the above | Count | 17 | 14 | 31 |
| | | Expected Count | 16,3 | 14,7 | 31,0 |
| | | % within No. of Years Being a Pediatrician | 54,8% | 45,2% | 100,0% |
| | | % within Making Use of an EMR Software or Not | 53,1% | 48,3% | 50,8% |
| | | % of Total | 27,9% | 23,0% | 50,8% |
| Total | | Count | 32 | 29 | 61 |
| | | Expected Count | 32,0 | 29,0 | 61,0 |
| | | % within No. of Years Being a Pediatrician | 52,5% | 47,5% | 100,0% |
| | | % within Making Use of an EMR Software or Not | 100,0% | 100,0% | 100,0% |
| | | % of Total | 52,5% | 47,5% | 100,0% |

**Table 13.** Cross-tabulation Statistics on No. of Years Being a Pediatrician in reference to EMR Use.

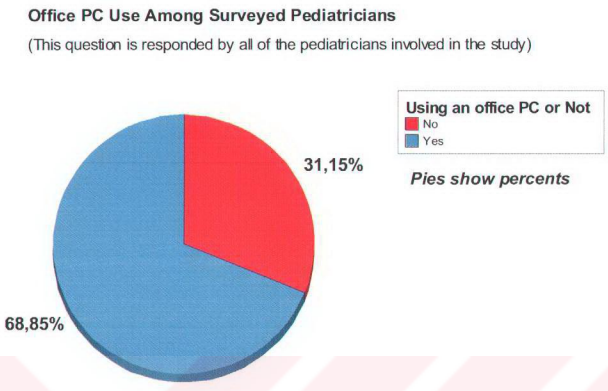



**Figure 11.** Statistics on the Use of Office Personal Computer (PC) Among Surveyed Pediatricians.

The survey also questioned pediatricians on whether they used an office PC or not. It has been revealed that out of 61 pediatricians surveyed, only 68,85% were using an office PC whereas the rest 31,15% were not using a PC in their offices. Comparison of this result with that of economically developed countries reveal that the rate of PC use among the surveyed pediatricians should need to be improved. According to Harris Interactive poll, the rate of PC use is 90% in Australia, 95% in Denmark, Netherlands, Sweden and England (Mullins et al.). In total figures, among those pediatricians who were using office PCs, 61,90% responded that they were using their PCs for keeping their patients' medical records, 50,47% of them were using their PCs for writing and archiving their documents like business letters and patient related reports while only 47,62%

were using their PCs for e-mailing and 32,86% were using them for surfing on the internet. Individually, 2,38% of them were using their PCs for keeping their patients' medical records and e-mailing. 9,52% were using the PC for writing and archiving documents such as business letters and patient related reports. Another 2,38% were using their PCs for surfing on the internet and e-mailing and writing and archiving their documents like business letters and patient related reports. 16,67% were using their PCs for both surfing the internet and e-mailing, while 7,14% were using their PCs for medical record keeping, internet and e-mailing. 11,90% were using their PCs for both medical record keeping and writing and archiving business letters and documents. 16,67% of the pediatricians were found out to be using their PCs for all of the purposes listed. Taken together, internet and e-mail use make up 80% of all the purposes listed for using office PCs. This suggests that there is a potential market out there for internet-based patient follow-up software. However, the difficult task would be to convince the other half of the pediatricians who do not use their office PCs for internet and/or e-mailing purposes.

**Purpose(s) for Using an Office PC**

(This question is responded by only those pediatricians who use office PCs)

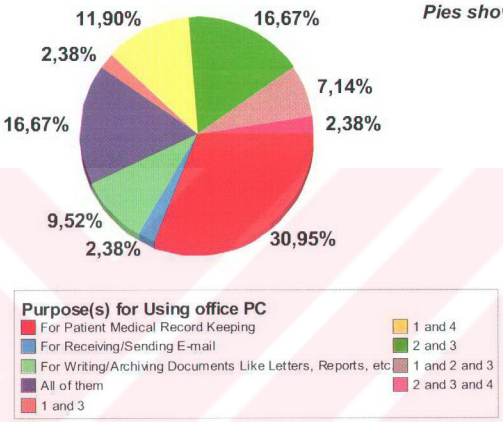



Figure 12. Purpose(s) for Using Office PC.

| | Frequency | Percent | Valid Percent |
|---|---|---|---|
| For Patient Medical Record Keeping Only (1) | 13 | 31,0 | 31,0 |
| For Internet Use Only (2) | - | - | - |
| For E-mailing (Send/Receive E-mail) Only (3) | 1 | 2,4 | 2,4 |
| For Writing/Archiving Documents Like Letters, Reports, etc. Only (4) | 4 | 9,5 | 9,5 |
| All of them (5) | 7 | 16,7 | 16,7 |
| Other (6) | - | - | - |
| Not Applicable (7) | - | - | - |
| 1 and 3 | 1 | 2,4 | 2,4 |
| 1 and 4 | 5 | 11,9 | 11,9 |
| 2 and 3 | 7 | 16,7 | 16,7 |
| 1 and 2 and 3 | 3 | 7,1 | 7,1 |
| 2 and 3 and 4 | 1 | 2,4 | 2,4 |
| Total | 42 | 100,0 | 100,0 |

Table 14. Purpose(s) for Using Office PC

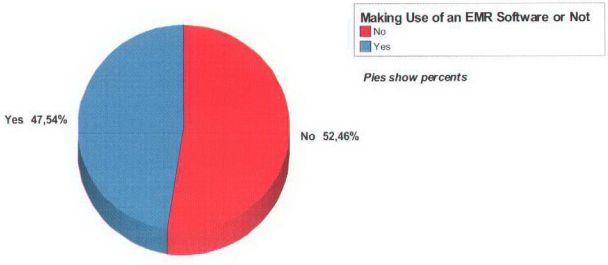



**Figure 13.** Pediatricians Making Use of an EMR Software (Type A) and Pediatricians who are not Making Use of an EMR Software (Type B).

Survey results showed that 52,46% of pediatricians were making use of an EMR software (Type A) whereas 47,54% were non-users (Type B). This revealed that the proportion of pediatric EMR users and non-users were about the same for the given sample. As mentioned in Chapter 1, the percentage of pediatricians who were using a computer system to store and to process patient data was found out to be 91% for a sample size of 800, in the U.S. If we were to assume that a sample size of 800 pediatricians were taken in İzmir region, the percentage would be around 52% which would be far less than the percentage found in the U.S. Rate of EMR use in other economically developed countries are as follows: 90% in Australia, 65% in Denmark, 88% in Netherlands, 90% in Sweden, and 99% in United Kingdom (Mullins et al.).

| Software Brand | Frequency | Percent | Valid Percent |
|---|---|---|---|
| IN HOUSE | 6 | 20,7 | 20,7 |
| ANAMNEZ (izmir) | 1 | 3,4 | 3,4 |
| DOKTORUM (istanbul) | 1 | 3,4 | 3,4 |
| EUROGROWTH (nestle) | 1 | 3,4 | 3,4 |
| GENOTIP (ankara) | 1 | 3,4 | 3,4 |
| MEDIKOSOFT (izmir) | 7 | 24,1 | 24,1 |
| MIRANDA SOFT (istanbul) | 6 | 20,7 | 20,7 |
| NETSIS | 1 | 3,4 | 3,4 |
| PEDIDBASE (izmir) | 1 | 3,4 | 3,4 |
| PEDISOFT (izmir) | 1 | 3,4 | 3,4 |
| PENTASOFT (izmir) | 1 | 3,4 | 3,4 |
| YAPAY ZEKA (izmir) | 2 | 6,9 | 6,9 |
| Total | 29 | 100,0 | 100,0 |

**Table 15.** Pediatric EMR Software Brands

Pediatric EMR software brands used by the surveyed pediatricians were listed on Table 15. Accordingly, MEDIKOSOFT and MIRANDA SOFT brands were the most popular among the pediatricians. Other brands included YAPAY ZEKA, ANAMNEZ, DOKTORUM, EUROGROWTH, GENOTIP, NETSIS (DOKTOR), PEDIDBASE, PEDISOFT, AND PENTASOFT. Surprisingly, some of the pediatricians have developed their own systems in-house. Each software had its own special features. MIRANDA SOFT, EUROGROWTH, DOKTORUM were all distributed by pharmaceutical companies at no cost for the pediatricians using them. All of the software listed were designed for local use only. Common features of these systems included patient identification and patient growth modules. In patient identification module, patient's system, personal and parental information were kept. Within the patient growth module, things such as growth curves and growth data were kept. Growth data included

height, weight and head circumference measures for every encounter with a particular patient. Growth values were represented as graphical curves (charts) for different percentile groups based on a particular patient's age. Most commonly used percentiles to compare a child's development were 5, 10, 25, 50, 75, 90, and 95 for a given growth value. Unfortunately, growth charts did not exist in some of these software. As mentioned earlier, EUROGROWTH was an extremely strong software in terms of displaying growth data and calculating statistical measures on the growth data. MIRANDA SOFT had a rich database on drug and vaccination information. GENOTIP was an easy to use software in which the pediatricians could store patients' laboratory test results, patients' immunization data, appointments, and billing information.

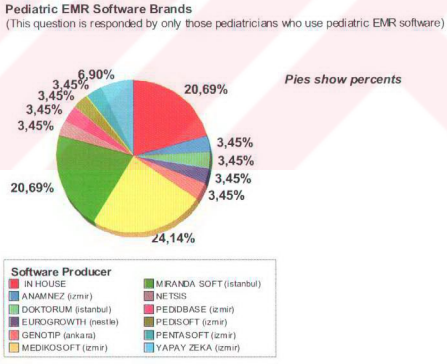



**Figure 14.** Pediatric EMR Software Brands.

Pediatricians were also questioned on their purpose(s) of using electronic patient follow-up software. Responses obtained from the survey showed that 82,76% of the pediatricians made use of their EMR software for all of the

purposes listed in Table 16. They were using the software for keeping their patients' personal and parental information, immunization data, control findings (visit notes), prescription information and keeping track of their patiens' growth. 3,45% claimed that they were making use of the EMR software for only keeping track of patient's growth. Another 3,45% claimed that they were making use of the EMR software for both keeping patients' personal and parental information and keeping track of patients' growth. Among the rest 10,35%, 3,45% stated that they were making use of the EMR software for storing patients' personal and parental information and control findings (visit notes) and for keeping track of patients' growth.

| | Frequency | Percent | Valid Percent |
|---|---|---|---|
| For Keeping Patient's Personal and Parental Information Only (1) | - | - | - |
| For Keeping Patient's Immunization Calendar Only (2) | - | - | - |
| For Following Patient's Growth Only (3) | 1 | 3,4 | 3,4 |
| For Keeping Patient's Control Findings Only (4) | - | - | - |
| For Keeping Patient's Prescription Information Only (5) | - | - | - |
| All of them (6) | 24 | 82,8 | 82,8 |
| 1 and 3 | 1 | 3,4 | 3,4 |
| 1 and 3 and 4 | 1 | 3,4 | 3,4 |
| 1 and 2 and 3 and 4 | 2 | 6,9 | 6,9 |
| Total | 29 | 100,0 | 100,0 |

**Table 16.** Purpose(s) of Using Electronic Patient Follow-up (EMR) Software.

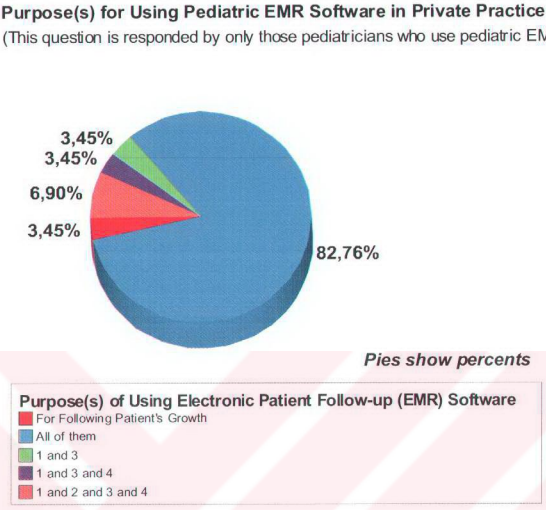



**Figure 15.** Purpose(s) for Using Pediatric EMR Software in Private Practice.

A question on the reason(s) for preferring electronic patient follow-up software use over traditional methods of patient record keeping, revealed the results listed in Table 17. According to these results, 41,38% of the respondents claimed that using electronic patient follow-up software provided them all types of advantages listed as reasons for preference. They all accepted that electronic patient follow-up systems provided them efficiency in using time, made archiving process easy, helped keeping office supplies expenses at the minimum level and provided easy reporting. 24,14% claimed that they preferred using electronic patient follow-up software over using traditional methods of patient record keeping because it provided them efficiency in using time and made archiving

process easy. 17,24% claimed that they preferred using electronic patient follow-up software over using traditional methods of patient record keeping because it provided them efficiency in using time, ease in archiving and reporting processes. 6,90% stated that using EMR software made only archiving process easy. 3,45% of the pediatricians claimed that they prefered using EMR because it provided them efficiency in using time and helped them keeping office supplies expenses at a minimum level. Another 3,45% indicated that the EMR software made archiving and reporting processes easier for them, and stated another reason as well. Finally, the rest 3,45% indicated that they preferred using EMR software because it only provided them efficiency in using time.

In aggregate, 90% of the pediatricians preferred using electronic patient follow-up (EMR) software over traditional methods of patient record keeping because of maximized time efficiency as stated in Chapter 1. Over 93% of the pediatricians claimed that they preferred EMR use over traditional methods because it provided convenient archiving and reduced chart pulls. In fact, this was also valid in nature when compared with the written literature on the subject. In total terms, nearly 45% of the respondents agreed that using EMR software helped them keep office supplies expenses at the minimum level. 62% of the respondents claimed that EMR use provided them with the ease of reporting that made them prefer EMR software. Easy reporting means better communication with the patient which in turn increases customer satisfaction as mentioned in Chapter 1.

| | Frequency | Percent | Valid Percent |
|---|---|---|---|
| Provides efficiency in using time Only (1) | 1 | 3,4 | 3,4 |
| Provides Ease in Archiving Process Only (2) | 2 | 6,9 | 6,9 |
| Helps Keeping Office Supplies Expenses at the Minimum Level Only (3) | - | - | - |
| Provides easy reporting Only (4) | - | - | - |
| All of them | 12 | 41,4 | 41,4 |
| Other Only (6) | - | - | - |
| 1 and 2 | 7 | 24,1 | 24,1 |
| 1 and 3 | 1 | 3,4 | 3,4 |
| 1 and 2 and 4 | 5 | 17,2 | 17,2 |
| 2 and 4 and 6 | 1 | 3,4 | 3,4 |
| Total | 29 | 100,0 | 100,0 |

**Table 17.** Reason(s) for Preferring Electronic Patient Follow-up (EMR) Software Use over Traditional Methods of Patient Record Keeping.

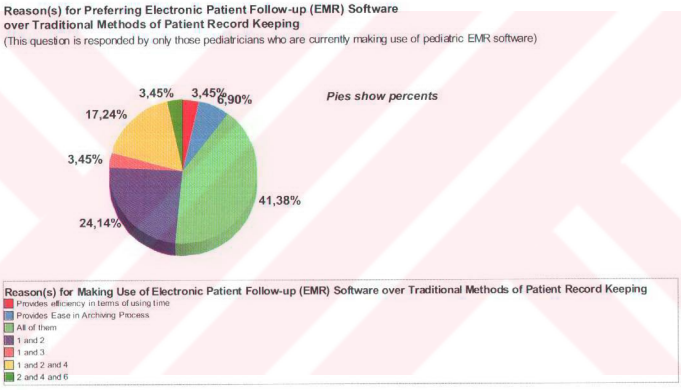



**Figure 16.** Reason(s) for Preferring Electronic Patient Follow-up (EMR) Software over Traditional Methods of Patient Record Keeping.

| | | Making Use of an EMR Software or Not | | Total |
|---|---|---|---|---|
| | | No | Yes | |
| Gender of Pediatrician | Female | 16 | 11 | 27 |
| | Male | 16 | 18 | 34 |
| Total | | 32 | 29 | 61 |

**Table 18.** Cross-tabulation Statistics on EMR Use in reference to Pediatrician's Gender.

The survey findings revealed that out of 27 female respondents, 41% of them were making use of a pediatric EMR software whereas out of 34 male respondents, 52% of them were making use of a pediatric EMR software for their private practices (See Figure 27). However, 78% of the female respondents were willing to adopt the web-based model compared to that of 76% of their male colleagues (See Figure 28).

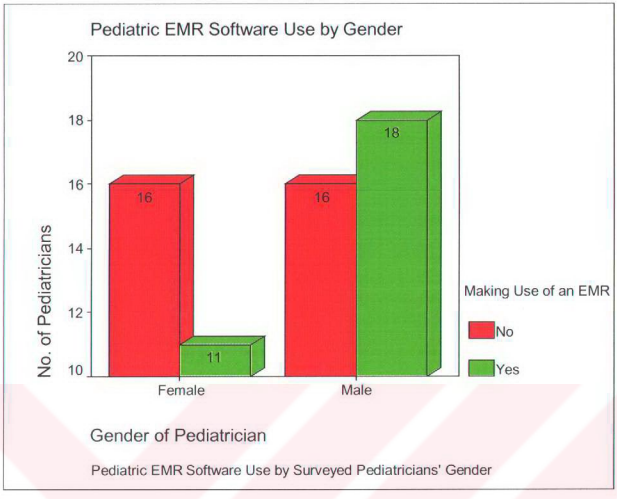



**Figure 17.** Pediatric EMR Software Use by Pediatricians' Gender.

| | | Willingness to Adopt the Web-based Patient Follow-up (EMR) Software | | Total |
|---|---|---|---|---|
| | | No | Yes | |
| Gender of Pediatrician | Female | 6 | 21 | 27 |
| | Male | 8 | 26 | 34 |
| Total | | 14 | 47 | 61 |

**Table 19.** Cross-tabulation Statistics on Willingness to Adopt the Web-based Patient Follow-up Software in reference to Pediatrician's Gender.

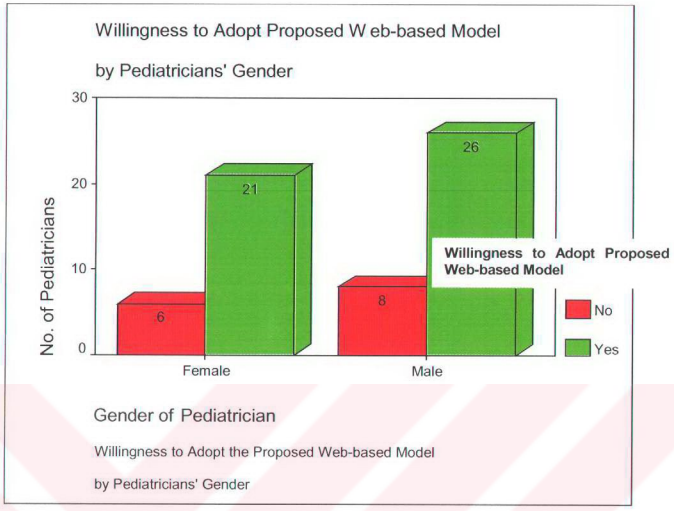



**Figure 18.** Willingness to Adopt Proposed Web-based Model by Pediatricians' Gender.

It is noteworthy, and consistent with a cohort explanation, that those pediatricians who were currently making use of a pediatric EMR software thought that the most important thing that could be done in terms of enhancing the capability of the EMR software which they were currently using, would be to put it on the internet (See Table 22). The second most important thing that could be done in terms of enhancing the capability of the software which they were currently using, would be to view radiological findings such as X-ray, MR, CT, EEG results electronically over their system. The third most important thing that could be done, would be to exchange various laboratory test results electronically over their system. The fourth most important thing to do in terms of enhancing the capability of the pediatric software for those pediatricians who were making use of a such system, would be to make their system more user-friendly by adding

graphical interfaces such as graphical growth curves, patient photos, etc. The least important thing that could be done, would be to get print outs of prescriptions automatically by the system.

| | N | Minimum | Maximum | Mean | | Std. Deviation | Variance |
|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Statistic |
| Can be Made Portable over the Internet | 29 | 1 | 5 | 2,10 | ,25 | 1,35 | 1,810 |
| Can be Made More User-Friendly (Graphical interfaces such as graphical growth curves, etc.) | 29 | 1 | 5 | 2,52 | ,27 | 1,43 | 2,044 |
| Radiological Findings (X-ray, MR, CT, EEG results) can be sent to the system electronically over the internet | 29 | 1 | 5 | 2,31 | ,21 | 1,14 | 1,293 |
| Various Laboratory Test Results can be sent to the system electronically over the internet | 29 | 1 | 5 | 2,38 | ,20 | 1,08 | 1,172 |
| Prescriptions can be printed out automatically by the system | 29 | 1 | 5 | 4,00 | ,24 | 1,31 | 1,714 |

**Table 20.** Descriptive Statistics on Various Factors that would Enhance the Capability of the Pediatric EMR Software Used by Surveyed Pediatricians

Graphical representations of response rates for each option which were listed under Question 18 are presented in the following figures (See Fig. 19-23).

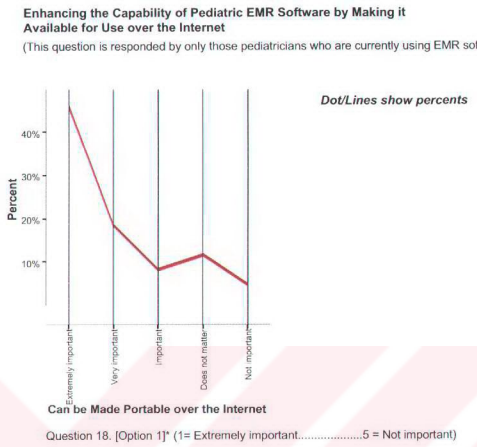
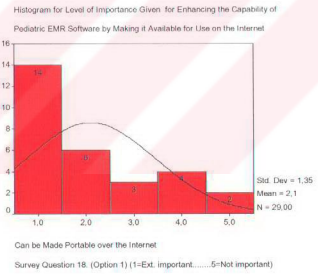



**Figure 19.** Importance Rate Given for Enhancing the Capability of Pediatric EMR Software by Making it Available on the Internet.




As shown in figure 19, above 40% of the surveyed pediatricians believed that it was extremely important to enhance the capability of the pediatric EMR software that they were currently using by making it available for use on the inetrnet. Within the left 40%, about 20% of them rated it as very important and slightly less than 10% rated it as important while the rest believed that it would make no difference or not important at all.

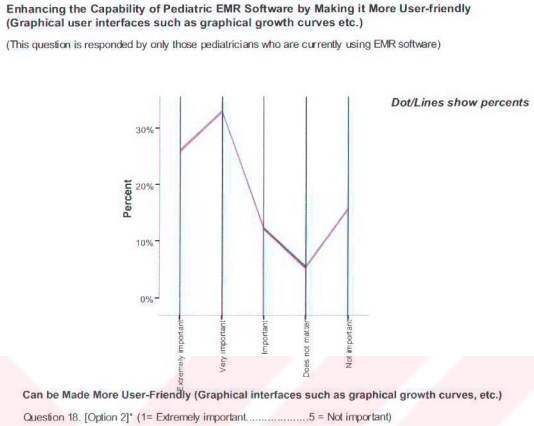
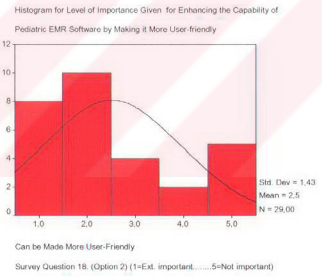


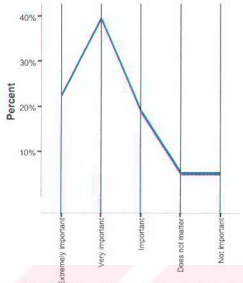

**Figure 20.** Importance Rate Given for Enhancing the Capability of Pediatric EMR Software by Making it More User-friendly.




As demonstrated in figure 20, nearly 30% of the surveyed pediatricians found it extremely important to enhance the capability of the pediatric EMR software that they were currently using by making it more user-friendly. Slightly over than a 30% of them found it very important. Within the left 40%, about 10% rated it as important while the rest found that it would either make no difference or not important at all to take such an action.

**Enhancing the Capability of Pediatric EMR Software by Making it Receive Radiographic Findings (X-ray, MR, CT and EEG results) Electronically over the Internet**

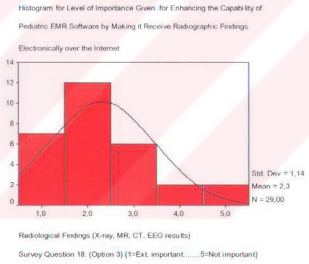
(This question is responded by only those pediatricians who are currently using EMR software)




**Radiological Findings (X-ray, MR, CT, EEG results) can be sent to the system electronically over the internet**

Question 18. [Option 3]* (1= Extremely important.....5 = Not important)

**Figure 21.** Importance Rate Given for Enhancing the Capability of the Pediatric EMR Software by Making it Receive Radiographic Findings Electronically over the Internet.




As illustrated in figure 21, between 20 to 25% of the respondents believed that it was extremely important to enhance the capability of the pediatric EMR software which they were currently using by making it receive radiological findings such as X-ray, MR, CT, and EEG results electronically over the internet. Another 40% found it very important. Within the left 35%, nearly 20% rated it as important while the rest believed that it would make no difference or not important at all to take such a step forward.

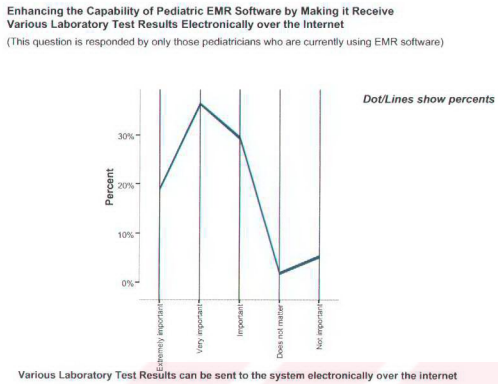
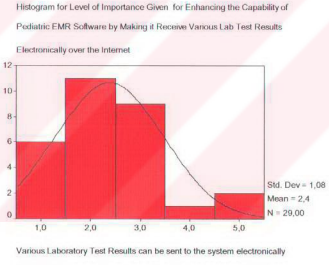



**Figure 22.** Importance Rate Given for Enhancing the Capability of Pediatric EMR Software by Making it Receive Various Laboratory Test Results Electronically over the Internet.




As shown on the graph illustrated in figure 22, 20% of the respondents found it extremely important to enhance the capability of the pediatric EMR software that they were currently using by making it receive various laboratory test results electronically over the internet. Over 30% rated it as very important. Within the left 40 to 45%, nearly 30% found it as important while the rest believed that it would make no difference or not important at all to take such an action.

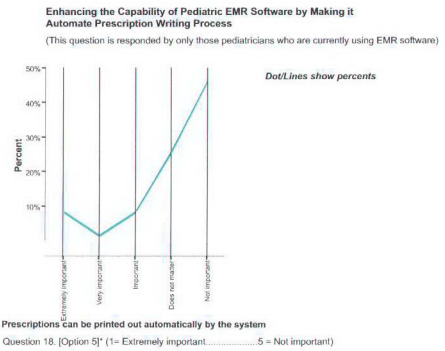



**Figure 23.** Importance Rate Given for Enhancing the Capability of Pediatric EMR Software by Making it Automate Prescription Writing Process.

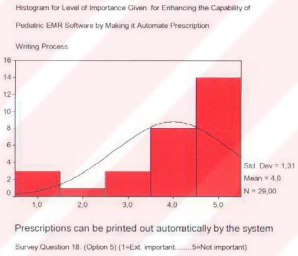



Figure 23 depicts the importance rate given for enhancing the capability of the pediatric EMR software by making it automate prescription writing process based on a scale of importance. Accordingly, none of the respondents found it extremely important to enhance the capability of the pediatric EMR software that they were currently using by making it automate prescription writing process. 10% of the respondents found it very important and nearly 5% rated it as important. On the other hand, about 15% of the respondents believed that it would make no difference and about 50% believed that it is not important at all to take such a step forward.

For those pediatricans who perceived web-based patient follow-up software favorable to adopt, 70,21% claimed that all of the reason(s) listed were positive factors influencing their decision to adopt the web-based model (See Figure 24). These reasons were being able to reach patient information anytime, anywhere, and in any format, being able to store patient information on a safe ISP server, being able to outsource data and virus protection services to the ISP company, being able to get a back-up for patient information whenever they want, flexibility for patients to reach their information anytime, anywhere and in any format, and being able to receive/view their patients' laboratory and radiology results electronically in real time (See Table 24). 6,38% responded that the proposed web-based model was attractive to adopt because of being able to reach patient information anytime, anywhere, and in any format; providing flexibility for patients to access their information anytime, anywhere, and in any format; and being able to receive/view their patients' laboratory and radiology results electronically in real time (See Figure 24). Another 6,38% responded that they perceive the proposed web-based model favorable to adopt because of being able to reach patient information anytime, anywhere, and in any format; being able to store patient information on a secure ISP server; being able to outsource data and virus protection services to the local ISP company; being able to get a back-up for patient information whenever they want; and being able to receive/view their patients' laboratory and radiology results electronically in real time (See Figure 24). 2,13% responded as reasons 1,2,4 and 6 (See Figure 24). Another 2,13% responded as reasons 1,3,4 and 6 (See Figure 24). 4,26% responded as reasons 1,4,5, and 6 (See Figure 24).

| | Freq. | Percent | Valid Percent |
|---|---|---|---|
| Being able to reach Patient Info. anytime, anywhere, in any format Only (1) | 3 | 6,4 | 6,4 |
| Being able to store Patient Info. On a Safe ISP Server Only (2) | - | - | - |
| Data and Virus Protection Services provided by the Local ISP Only (3) | - | - | - |
| Being able to get a back-up for Patient Info. whenever I want Only (4) | - | - | - |
| Flexibility for Patients to reach their Info. anytime, anywhere, in any format Only (5) | 1 | 2,1 | 2,1 |
| Being able to Receive/View Patient Lab. Results electronically in real time Only (6) | - | - | - |
| All of them (7) | 33 | 70,2 | 70,2 |
| Not Applicable (8) | - | - | - |
| 1 and 5 and 6 | 3 | 6,4 | 6,4 |
| 1 and 2 and 4 and 6 | 1 | 2,1 | 2,1 |
| 1 and 3 and 4 and 6 | 1 | 2,1 | 2,1 |
| 1 and 4 and 5 and 6 | 2 | 4,3 | 4,3 |
| 1 and 2 and 3 and 4 and 6 | 3 | 6,4 | 6,4 |
| Total | 47 | 100,0 | 100,0 |

**Table 21.** Reason(s) for Perceiving Internet-based (web-based) Patient Follow-up Software Favorable to Adopt.

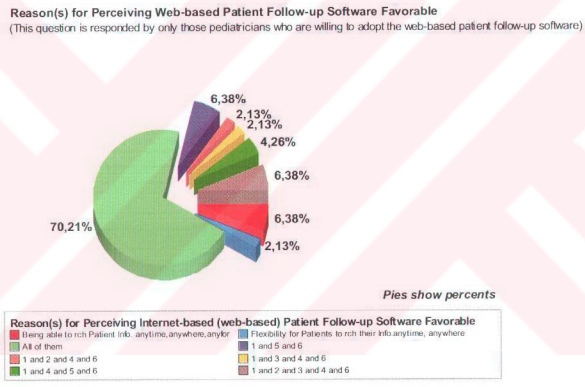



**Figure 24.** Reason(s) for Perceiving Web-based Patient Follow-up Software Favorable to Adopt.

On the other hand, for those pediatricians who perceived web-based patient follow-up software unfavorable to adopt, 21,43% responded that all of the reasons listed, contributed to their unfavorable perception (See Figure 25). These reasons were both personal and technical. Personal reasons included having no time to spend on computers and/or new technologies and no prior

experience on using pediatric EMR software of any type and finding it unethical to have patient information over the internet environment (See Table 22). Technical reasons included things such as potential virus and hacker attacks on the internet environment, potential risk of losing patient data, slow internet connection speed (See Table 22). Another 21,43% responded as having no time to spend on computers and/or new technologies, potential virus and hacker attacks over the internet environment, slow internet connection speed, and potential risk of losing patient data. 14,29% responded as finding it unethical to disclose patient information over the internet, potential virus and hacker attacks over the internet environment, slow internet connection speed, and potential risk of losing patient data for perceiving the proposed web-based model unfavorable. The other group of pediatricians with the same response rate listed their reasons for perceiving the proposed web-based model unfavorable as finding it unethical to disclose patient information over the internet, potential virus and hacker attacks over the internet environment, and potential risk of losing patient data. From the four groups of pediatricians with a 7,14% response rate, the first one listed only having no time to spend on computers and/or new technologies as their biggest concern for not willing to adopt the proposed web-based model. The second group claimed that they found it unethical to have patient information over the internet environment as their only reason for perceiving to adopt the proposed model unfavorable. The third group with a 7,14% response rate, responded that they had no time to spend on computers and/or new technologies and no prior experience on using any type of pediatric EMR software. The last group complained about having no time to

spend on computers and/or new technologies and the potential risk of losing patient data. In addition to these reasons, some of the pediatricians were concerned about tax audits while some were concerned about low level of computer literacy among their patient portfolios as other reasons which contribute to their unfavorable perception. Other reasons included things such as the belief that patients won't accept technology and disruption to office operations.

| | Freq. | Percent | Valid Percent |
|---|---|---|---|
| No Time to spend for Computers/New Technologies Only (1) | 1 | 7,1 | 7,1 |
| No prior experience on using pediatric EMR software of any type Only (2) | - | - | - |
| Find it Unethical to have Patient Info. over the Internet Only (3) | 1 | 7,1 | 7,1 |
| Potential virus and hacker attacks on the internet environment Only (4) | - | - | - |
| Slow internet connection speed Only (5) | - | - | - |
| Potential risk of losing patient data Only (6) | - | - | - |
| All of them (7) | 3 | 21,4 | 21,4 |
| Not Applicable (8) | - | - | - |
| 1 and 2 | 1 | 7,1 | 7,1 |
| 1 and 6 | 1 | 7,1 | 7,1 |
| 3 and 4 and 6 | 2 | 14,3 | 14,3 |
| 1 and 4 and 5 and 6 | 3 | 21,4 | 21,4 |
| 3 and 4 and 5 and 6 | 2 | 14,3 | 14,3 |
| Total | 14 | 100,0 | 100,0 |

**Table 22.** Reason(s) for Perceiving Internet-based (web-based) Patient Follow-up Software Unfavorable to Adopt.

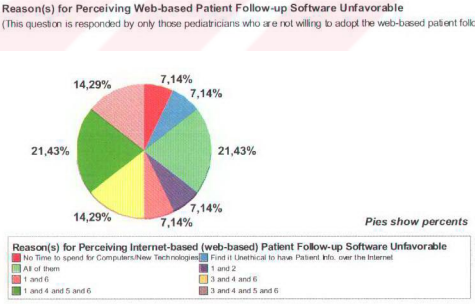



**Figure 25.** Reason(s) for Perceiving Web-based Patient Follow-up Software Unfavorable to Adopt.

Most of the pediatric EMR software used by the surveyed pediatricians were found out to be on-the-shelf software. In general pediatricians preferred on-the-shelf software because of their low-cost or no cost and quality service provided by the software companies. Out of 29 pediatricians who use EMR software, only 18 pediatricians were using on-the-shelf software which corresponds to 62% of the total number of pediatricians who were making use of a pediatric EMR software (See Figure 27). On the other hand, 11 pediatricians were making use of customized software which corresponds to 38% of the total number of pediatricians who were making use of a pediatric EMR software (See Figure 27). The reasons for using customized software were their ease of use and customized features such as personalized screen and report formats. Most of the customized software used by the surveyed pediatricians were in-house made. Those pediatricians who were making use of in-house made software, claimed that they would know their needs better than anyone else since they were personally involved in the profession.

| | | Customized or On-the-Shelf Software | | |
|---|---|---|---|---|
| | | On-the-Shelf Software | Customized Software | Total |
| Software Brand | IN HOUSE | | 6 | 6 |
| | ANAMNEZ (izmir) | | 1 | 1 |
| | DOKTORUM (istanbul) | 1 | | 1 |
| | EUROGROWTH (nestle) | 1 | | 1 |
| | GENOTIP (ankara) | 1 | | 1 |
| | MEDIKOSOFT (izmir) | 7 | | 7 |
| | MIRANDA SOFT (istanbul) | 6 | | 6 |
| | NETSIS | | 1 | 1 |
| | PEDIDBASE (izmir) | | 1 | 1 |
| | PEDISOFT (izmir) | 1 | | 1 |
| | PENTASOFT (izmir) | 1 | | 1 |
| | YAPAY ZEKA (izmir) | | 2 | 2 |
| Total | | 18 | 11 | 29 |

**Table 23.** Crosstabulation Statistics on Software Brand in reference to Software Type.

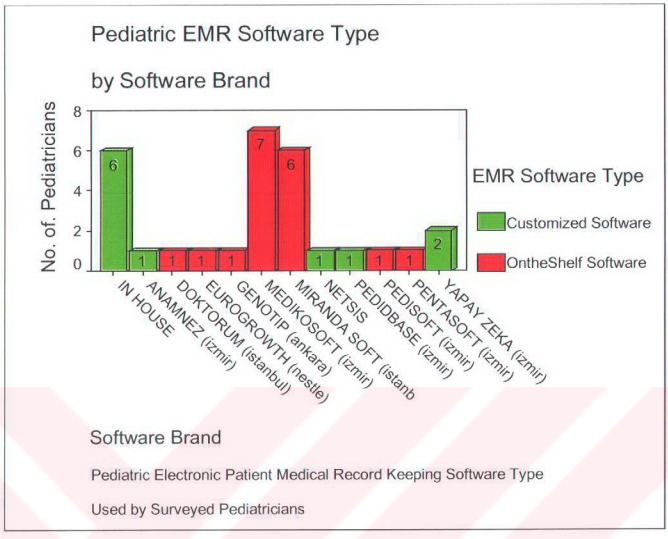



**Figure 26.** Pediatric EMR Software Type by Software Brand.

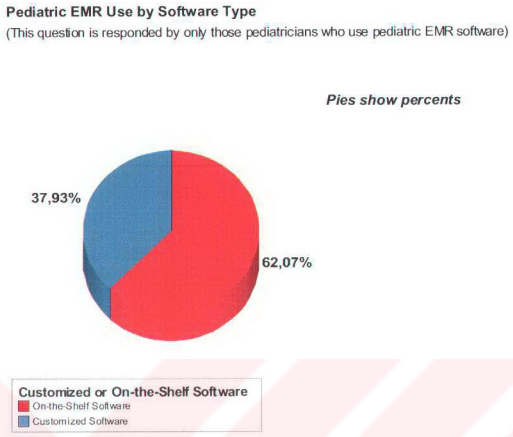



**Figure 27.** Pediatric EMR Use by Software Type.

The survey findings revealed that 68,97% of the pediatricians used all of the module(s) which could possibly be integrated within a pediatric EMR software (See Figure 28). These were patient immunization calendar, patient growth, patient identification, patient laboratory test results, and patient medical record modules (See Table 26). 6,90% claimed that they were using patient growth and patient identification modules most frequently (See Figure 28). Another 6,90% claimed that they were using all of the modules listed and an extra module on the radiographic findings on a frequent basis (See Figure 28). From the five groups of pediatricians with a 3,45% response rate, the first group asserted that they were using the patient immunization calendar and patient medical record modules most often (See Figure 28). The second group with the same response rate asserted that they were using patient immunization calendar,

patient growth and patient medical record modules (See Figure 28). The third group claimed that they were using patient identification, patient laboratory test results, and patient medical record modules on a frequent basis (See Figure 28). The fourth group with a 3,45% response rate claimed that they were using all of the modules listed except the module on patient laboratory test results (See Figure 28). Finally, the fifth and the last group asserted that they were using the patient growth module most frequently (See Figure 28).

| | Frequency | Percent | Valid Percent |
|---|---|---|---|
| Patient Immunization Calendar Only (1) | - | - | - |
| Patient Growth Curves Only (2) | 1 | 3,4 | 3,4 |
| Patient Personal Information Only (3) | - | - | - |
| Patient Laboratory Test Results Only (4) | - | - | - |
| Patient Medical Record History Only (5) | - | - | - |
| All of them (6) | 20 | 69,0 | 69,0 |
| Other (7) | - | - | - |
| 1 and 5 | 1 | 3,4 | 3,4 |
| 2 and 3 | 2 | 6,9 | 6,9 |
| 6 and 7 | 2 | 6,9 | 6,9 |
| 1 and 2 and 5 | 1 | 3,4 | 3,4 |
| 3 and 4 and 5 | 1 | 3,4 | 3,4 |
| 1 and 2 and 3 and 5 | 1 | 3,4 | 3,4 |
| Total | 29 | 100,0 | 100,0 |

**Table 24.** Most Frequently Used Module(s)/Process(es) of the EMR Software.

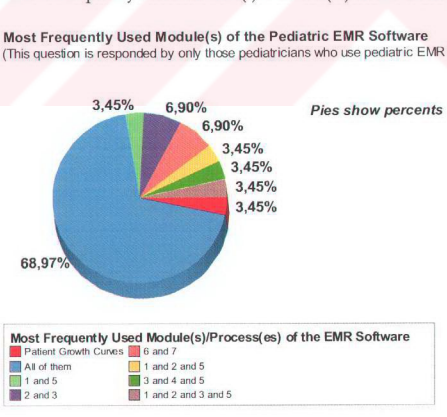



**Figure 28.** Most Frequently Used Module(s) of the Pediatric EMR Software.

| | | Frequency | Percent | Valid Percent |
|---|---|---|---|---|
| Unfavorable Prices | (1) | - | - | - |
| Not practical for Use | (2) | 1 | 3,1 | 3,1 |
| Not Interested/Very Good in Using Computers | (3) | 2 | 6,3 | 6,3 |
| Having a Limited No. of Patients | (4) | 3 | 9,4 | 9,4 |
| Difficult for me to leave old habits aside | (5) | 1 | 3,1 | 3,1 |
| All of them | (6) | 1 | 3,1 | 3,1 |
| Other | (7) | 5 | 15,6 | 15,6 |
| 3 and 5 | | 7 | 21,9 | 21,9 |
| 5 and 7 | | 5 | 15,6 | 15,6 |
| 2 and 3 and 7 | | 1 | 3,1 | 3,1 |
| 2 and 5 and 7 | | 1 | 3,1 | 3,1 |
| 3 and 4 and 5 | | 3 | 9,4 | 9,4 |
| 3 and 5 and 7 | | 2 | 6,3 | 6,3 |
| Total | | 32 | 100,0 | 100,0 |

**Table 25.** Reason(s) for not Using Electronic Patient Follow-up (EMR) Software.

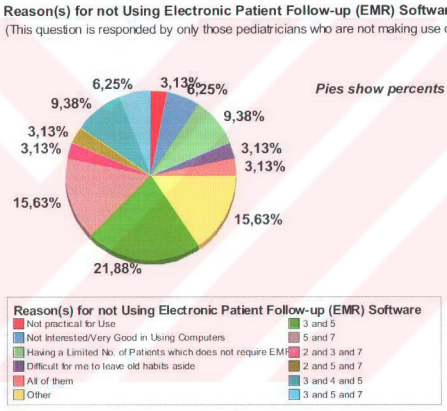



**Figure 29.** Reason(s) for Not Using Electronic Patient Follow-up (EMR) Software.

For those pediatricians who were not making use of a pediatric EMR system, 21,88% stated their reason for not making use of an EMR system as either being not interested or not very good at using computers and difficult for them to leave their old habits aside (See Figure 29). 15,63% claimed that it was difficult for them to leave their old habits aside and because of another reason (See Figure 29). Another 15,63% stated other reasons for not making use of an

EMR system (See Figure 29). Within the 5 groups with 3,13% response rate, the first group claimed that they were not using an electronic patient follow-up system because it was not practical for use. The second group believed that all of the reasons listed could contribute to their decision for not making use of an EMR system. The third group claimed that it was difficult for them to leave their old habits aside. The fourth group stated their reasons for not using an EMR system as both impractical use of EMR systems, them being not interested or not very good at using computers and because of another reason. And the fifth group claimed that they were not making use of an EMR system because of their impractical use, and it was difficult for them to leave their old habits aside and because of other reasons. From the two groups with 9,38% response rate, the first one claimed that they were not making use of an EMR software because of having a small patient portfolio which does not require EMR use. The second group with the same response rate stated their reasons for not using an EMR software as being not interested or not very good at using computers, having a small patient portfolio, and the difficulty they face in leaving their old habits aside. Within the left 12,50%, half the pediatricians stated their reasons for not making use of an EMR system as being either not interested or not very good at using computers, difficulty they would face in leaving their old habits aside, and other reasons while the other half claimed that they were either not interested or not very good at using computers (See Figure 29). Among the other reasons specified for not making use of EMR software, the most frequently mentioned ones were the pediatricians' hesitation of a tax audit and data entry concerns.

| | | Frequency | Percent | Valid Percent |
|---|---|---|---|---|
| Allows Using My Time Efficiently Only | (1) | 7 | 24,1 | 24,1 |
| Makes it Easy for One-to-One Communication with the Patients Only | (2) | 2 | 6,9 | 6,9 |
| Makes routine processes such as report generation, invoicing, etc. easy Only | (3) | - | - | - |
| All of them | | 7 | 24,1 | 24,1 |
| 1 and 2 | | 10 | 34,5 | 34,5 |
| 1 and 3 | | 2 | 6,9 | 6,9 |
| 2 and 3 | | 1 | 3,4 | 3,4 |
| Total | | 29 | 100,0 | 100,0 |

**Table 26.**Convenience(s) Gained by EMR Use.

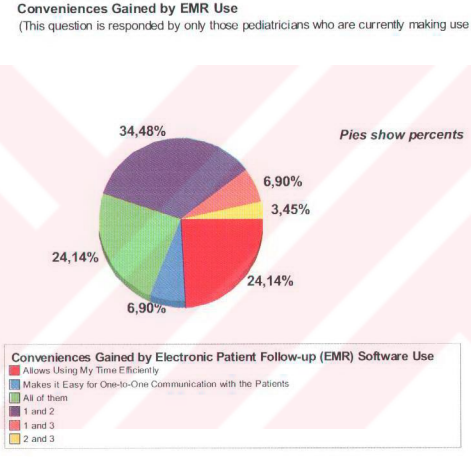



**Figure 30.**Conveniences Gained by EMR Use.

Among those pediatricians who were making use of a pediatric EMR software, 34,48% believed that EMR software allowed them use time more efficiently and made things easier when it came to communicate with the patients (See Figure 30). 24,14% believed that all of the conveniences listed were valid for EMR use while another 24,14% asserted that EMR use only allowed them use time more efficiently (See Figure 30). Within the two groups with 6,90%

response rate, the first group believed that EMR use made it more convenient to communicate with their patients during one-on-one encounters (See Figure 30). The second group thought that EMR use allowed them both using time more efficiently and made routine processes such as report generation, invoicing and other paper work more convenient. The rest 3,45% claimed that EMR use made it more convenient to communicate with their patients and made routine processes such as report generation , invoicing and handling other types of paperwork much easier (See Figure 30). In aggregate figures, %90 of the pediatricians believed that EMR use allowed them using time more efficiently while 69% believed that EMR use made it easier to communicate with the patients.

In a research study done in Canada, similar results were found concerning conveniences gained by EMR use. EMR users exhibited a high level of agreement with the statements that "*EMR can improve physicians' work efficiency and time management, EMR can reduce overall practice expenses, and EMR can improve the patient-doctor relationship*" (Kazimirski et al. 8).

| Factors<br><br>(Ratings on a 0 to 5 scale, 0=Strongly Disagree... ..5=Strongly Agree) | Current users<br><br>n = 376 |
|---|---|
| **"EMR can improve physicians' work efficiency and time management"** | 3.85 |
| **"EMR can reduce overall practice expenses"** | 2.99 |
| **"EMR can improve the patient-doctor relationship"** | 2.60 |

Source- Kazimirski, Mark; Renaud, Claude; Sawaya, Lou; Zitner, David; Korman, Roger. "Computer Literacy and Electronic Medical Records" The College of Family Physicians of Canada. (2002).

**Table 27.** Physicians Level of Agreement Concerning Conveniences Gained by EMR Use.

## 2.4 Conclusions

More family physicians are using computer systems in their practices in more ways than ever before. In today's small to mid-sized family practice, you might find a computer system used for patient account management and electronic claims filing. It has been a hard-fought battle for computers to reach this stage. And you might, too, have your own battle when purchasing a computer system. Before everything, potential users of electronic medical record keeping software should remember that implementation of an EMR system requires a strong personal commitment. An EMR is valuable only if users are willing to change the way they do business so that the technology works for them.

Two issues were addressed in this study: (1) statistical inferences obtained from the investigation on the pediatric electronic medical record keeping software (EMR) use among pediatricians in İzmir metropolitan area, and (2) proposal of a web-based patient follow-up model and its adoptability for pediatric private practice. Regarding the first issue, the data suggest that the rate of office PC use among surveyed pediatricians was 68,85% while slightly less than half the pediatricians surveyed, were making use of EMR software in their private offices. Among the users of office PC, 32,86% had an internet access and 47,62% made use of e-mail. Comparison of these results with that of economically developed countries such as U.S. and Canada, the response rates are 65% in Canada and 91% in the U.S. for pediatric EMR use, 71% in Canada and 72.8% in the U.S. for internet use, 50% in Canada and 59% in the U.S. for e-mail use (Kazimirski et al. 6). When it comes to European countries, they are leading the race in technology use for patient records against the U.S. American doctors use internet and

computers more than their European counterparts; however they trail much of Europe in adopting electronic medical records. 80% of the physicians within the European Union countries use computers in their practice while 61% of them use the internet or e-mail services. In the most economically developed countries of Europe, rate of EMR use is even higher than that of U.S. For instance, 90% of Swedish, 88% of Dutch, 65% of Danish physicians make use of EMR software for their practices (Brailer, and Terasawa 17). Among the users of pediatric EMR software, 62,07% were making use of on-the-shelf software whereas 37,93% were making use of customized software (including in-house built).

Responses given for the other EMR specific questions were valid in nature when the similar studies done by different scholars were considered. Indeed, it was very true that most of the surveyed pediatricians, especially those who had no prior experience with an EMR software and those who had a large patient portfolio claimed that it would be very hectic to enter all patient data on a computer. Majority of the pediatricians thought that the most important thing to do in terms of enhancing the capability of the software that they were currently using, would be to put it on the internet. Indeed, this could be considered as a sign of realization of the potential rewards of internet use among surveyed pediatricians. Turning to the second issue, selecting a computer system, for your practice is not an easy undertaking. As technology advances, the choices in potential applications can be overwhelming. Web-based technology and electronic medical records (EMRs) have introduced an entirely new spectrum of clinical applications with seemingly limitless potential. Yet the time, energy and money you invest in a new computer system will ultimately increase your practice's

productivity and efficiency. A computer system offers many advantages for improving the solo and administrative performance within a pediatric practice. The amount of time formerly spent by physicians and staff sifting through piles of paper can be used to see more patients, thus increasing productivity. For this reason, a web-based model of an EMR system is developed for those pediatricians who are working privately. The steps involved in the development of the web-based patient follow-up software are presented in detail throughout the study. Survey results revealed that over 3/4 (77%) of the respondents were willing to adopt the proposed web-based model for their private practices. This shows that there exists a potential market for the proposed web-based patient follow-up software among the pediatricians in İzmir. It was also found out that there is negative association between current EMR use and willingness to adopt the proposed web-based model. This suggested that Type B pediatricians were more willing to adopt the proposed web-based model than Type A pediatricians. Despite Type B pediatricians were more willing to adopt the proposed model, those pediatricians who were making use of EMR software believed that making the software available for use over the internet would be the most important thing that could be done in terms of enhancing the capability of their software.

Given that only 47,5% of respondents are personally using EMR systems at their workplace, it suggests that the pediatricians of İzmir are in need to become more literate in using computer technologies in order to reach standards in economically developed countries and their level of willingness to adopt the proposed web-based model should be considered as a sign of moving in the right direction. A change in habits is what is needed and it is apparent from the survey

results that pediatricians of İzmir are very enthusiastic and ready to be a part of this change.

## 2.5 Future Research

For future research, the study can be used as a comparison for further investigation in pediatric EMR use with the other metropolitans in Turkey. For instance, study results which will be conducted on the subject matter in Ankara and İstanbul can be compared with these results and a better conclusion can be reached about the current state of technology use by the pediatricians in the entire nation. The figures then can be used as a comparison with that of other nations. Better conclusions can be drawn about the subject matter in the city of İzmir as a whole if the study can be expanded to the non-metropolitan districts.

Proposed web-based model can be developed further for commercial purposes. It can be customized according to the specific business needs of pediatricians and put in practice.

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# APPENDIX A

## A-1. Checklist for EMR Systems

| **Encounter-Progress Notes** | **Yes** | **No** |
|---|---|---|
| 1.Can encounters be recorded electronically in some fashion? | | |
| 2.Can the electronic record by accessed during patient visits? | | |
| 3.Does the system allow full electronic availability of encounter-progress notes? | | |
| 4.Does the system allow scrollable encounter-progress notes? | | |
| 5.Does the system offer tested templates for the creation of encounter-progress notes? | | |
| 6.Are the templates easily modified? (Ask for a demonstration.) | | |
| 7.Does the system offer encounter retrieval by: | | |
| Last name? | | |
| First name? | | |
| Date of birth? | | |
| Identification number? | | |
| Family grouping? | | |
| Problem type? | | |
| Date? | | |
| Chronology? | | |
| Text search? | | |
| 8.Can the encounter-progress note indicate duration of encounter? | | |
| 9.Can encounter-progress note indicate visit type (e.g., scheduled vs. work-in, etc.)? | | |
| 10.Can the encounter-progress note indicate facility type? | | |
| 11.Can the encounter-progress note indicate provider involved? | | |
| 12.Can the encounter-progress note indicate chief complaint? | | |
| 13.Can the encounter-progress note document the history of present illness? | | |
| 14.Can the encounter-progress note document physical examination findings? | | |
| 15.Can the encounter-progress note indicate procedures performed and planned? | | |
| 16.Can the encounter-progress note indicate lab performed and planned? | | |

17.Can the encounter-progress note indicate diagnoses?

18.Can the encounter-progress note indicate provider goals?

19.Can the encounter-progress note indicate patient goals?

20.Can the encounter-progress note indicate medications prescribed?

21.Can the encounter-progress note indicate patient education materials provided?

22.Can the encounter-progress note indicate consultations/referrals?

23.Can the encounter-progress note indicate condition or status?

24.Can the encounter-progress note indicate follow-up plans?

25.Can the encounter-progress note be problem-oriented?

Linked to diagnosis?

Linked to problem number?

| **Medical History** | **Yes** | **No** |
|---|---|---|
| 1.Does the system offer electronic medical histories? | | |
| 2.Does the system offer obstetrical history? | | |
| 3.Does the system document hospitalization? | | |

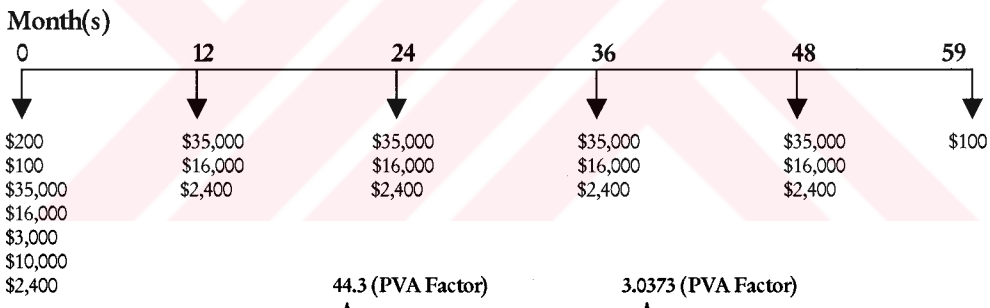
## A-2. Paper charts vs. EMR: A dollars and cents demonstration

Cost for a five-physician family practice over five years

| | | |
|---|---|---|
| Paper Charts | | |
| Initial paper purchase | $ | 200 |
| Continuing paper purchase per month | $ | 100 |
| Transcription services | $ | 175,000 |
| Medical records clerk | $ | 80,000 |
| Dictation equipment | $ | 3,000 |
| Copy machine | $ | 10,000 |
| Copy machine maintenance | $ | 12,000 |
| **FIVE-YEAR DISCOUNTED TOTAL :** | **$** | **233,322** |
| Electronic Medical Records | | |
| Initial hardware and software costs (including training for 10 employees) | $ | 150,000 |
| Software support | $ | 108,000 |
| **FIVE-YEAR DISCOUNTED TOTAL:** | **$** | **229,768** |
| **NET SAVINGS:** | **$** | **3,554** |

Reprinted with permission from *FP Report,* American Academy of Family Physicians, June 1997.

### Paper Charts

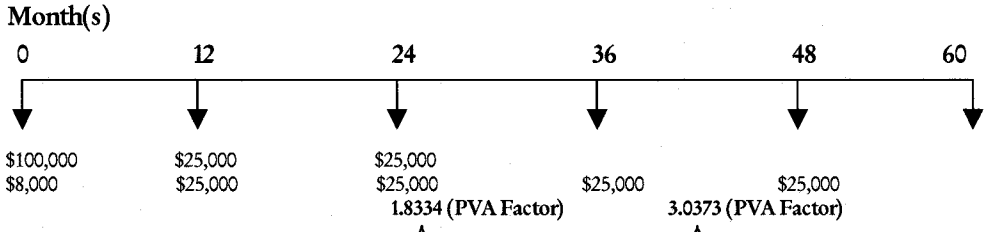



$$P_{PC}^{*} = 66{,}700 + 100(P/A, \%1, 59) + 53{,}400\,(P/A, \%12, 4)$$

$$P_{PC}^{*} = \$233{,}322$$

(*Present Worth)

### Electronic Medical Records




$$P_{EMR}^{*} = 108{,}000 + 25{,}000(P/A, \%6, 2) + 25{,}000(P/A, \%12, 4)$$

$$P_{EMR}^{*} = \$229{,}768$$

(*Present Worth)

## A-3. Exhibit on Sample Benefits of Electronic Medical Records System

LEGEND FOR CHART:

Productivity enhancements

Tangible financial benefits

* Reduction in chart plus reduces labor cost in medical records department,
* Automated interface reduce labor costs for personnel involved in coding, billing, manually retrieving lab results, and referral coordination.
* Transcription costs.
* Malpractice premium lowered.
* Less dictation time, faster documentation of encounters.
* Improved charge capture, documenting home health management.
* Reduced nurse intake time.
* Faster billing reduces cash cycle, cuts receivable days.
* Document storage space costs reduced.

Intangible financial benefits

* Scheduling of resources becomes more efficient
* Easier QA and UR reporting.
* Less time spent copying, filing, faxing and transmitting data.
* Lower supply costs.
* Fewer lab results lost, repeat tests.
* Aggregate patient data improves financial forecasting, risk assumption.
* Automation of referral process and more appropriate use of specialists.

Quality of care improvements

Tangible financial benefits

* Automated protocols/guidelines reduce expensive variations in patient treatment.
* Less time needed to search through records for relevant patient information.
* Decrease in lost lab reports reduces cost of repeat lab tests.

Intangible financial benefits

* Reduced medication errors, adverse drug interactions.
* Improved primary and preventive care (through automated reminders, protocols and alerts) reduces disease management costs, specialty and in-patient care.
* Availability of chart vastly improved.
* Improved data analYsis, outcomes measurement, population-based care.
* Remote access to patient charts.
* Summary screen helps prevent over-looked patient information.
* Ease of providing summary information helps specialists with care.
* Less need for repeat lab testing
* Ease of getting medication refills authorized; faster turnaround time on refill requests.
* Less paperwork as patients move throughout the healthcare system.

Nonfinancial benefits

* Improved quality of documentation and legibility.
* Improved outcomes reporting.
* Less information falls through the cracks inc a continuum of care.

Improved customer service, satisfaction

Intangible financial benefits

* Less need for repeat lab testing.
* Ease of getting Medication refills authorized; faster turnaround time on refill requests.
* Less paperwork as patients move throughout the healthcare system.

Nonfinancial benefits

* Confidence physicians are using the best information technology available.
* Improved communication with pre-formatted letters, educational handouts, etc.

Increased professional satisfaction

Tangible financial benefits

* More time to spend with patients.

Intangible financial benefits

* Reduction in paperwork
* Improved communication and less time consumed with routine information exchange.

Nonfinancial benefits

* Increased satisfaction with availability, documentation of records, efficiency of chart reviews and signing, etc.
* Ease of covering for other providers' patients.
* Ease of tracking referred patients.

# APPENDIX B

## B-1. Survey (English Translation)

**An Application of a MIS in Health Care Sector**

**An Investigation on the Use of Patient Follow-up (EMR) Software by Pediatricians in İzmir and The Proposal of a Web-based Model**

This questionnaire is primarily designed for collecting information from pediatricians on the use of electronic medical record keeping systems in their private offices and their opinions on the proposed web-based EMR model. Answers for questions which will be obtained on this survey will be used for research purposes only. The information provided by the respondents will be kept confidential unless otherwise is stated. Please take your time completing this survey. At least one answer for each close-ended question marked with a "*" sign is required. Be specific, objective and accurate as much as you can! Thank you very much for your cooperation and patience.

**Questions marked with a * are required.**

***1.** Pediatrician's Name and Surname

***2.** What is your medical school of specialization (medical school which the degree is obtained)?

***3.** What is your area of specialty?

***4.** District in which pediatrician's private office is located

☐Bornova ☐Buca ☐Güzelbahçe ☐Karşıyaka ☐Konak ☐Narlıdere

***5.** How long have you been a pediatrician?

__0-1 year __1-3 years __3-6 years __6-9 years __9-12 years __12-15 years __More

***6.** How long do you have your own private office?

__0-1 year __1-3 years __3-6 years __6-9 years __9-12 years __12-15 years __More

***7.** Do you have a personal computer (PC) in your office?

__Yes __No

**8.** If your answer to the previous question is "YES", for what purpose(s) are you using your office PC for?

___For Patient Medical Record Keeping

___For Internet Use

___For E-mailing (Sending/Receiving e-mail)

___For Writing and Archiving Documents such as Business Letters, Patient Reports

___Other: (Please specify)

***9.** Are you making use of pediatric EMR software in your office?

____Yes ___No

**10.** If your answer for the previous question is "NO", what is/are your reason(s) for not using pediatric EMR software?

____Unfavorable Prices

_____Not Practical for Use

_____Not Interested/Very Good at Using Computers

____Having a limited patient population which does not require use of EMR software

_____Being Unable to Get Rid of my Old Habits/Beliefs

_____All of them _____Other: (Please specify)

**(Please answer questions 11-18 if you are using pediatric EMR software!)**

**11.** What is the brand of the pediatric EMR software that you are currently using?

___NETSIS ___LOGO ___ETA ___EGE BIMTES ___Other: (Please specify)

**12.** What is/are the reason(s) behind your brand preference of the pediatric EMR software that you are currently using?

☐ Trustworthy Brand

☐ First-class Quality

☐ Service Understanding of the Software Producer which Meets Expectations

☐ Favorable Price

☐ All of them

**13.** Is the pediatric EMR software that you are using, a customized or an off-the-shelf solution?

____On-the-shelf Solution

_____Customized Solution

**14.** What is/are the module(s) that you most frequently use within the pediatric EMR software?

___Patient Immunization Calendar

____Patient Growth Curve/Chart

____Patient Personal Information

____Patient Laboratory Test Results

____Patient Medical Record History (Control Findings and Prescribed Medicines)

____All of them

____Other: (Please specify)

**15.** For what purpose(s) do you make use of the pediatric EMR software?

____ For Keeping Patient's Personal and Parental Information

_____For Keeping Patient's Immunization Calendar

_____For Tracking Patient's Growth

_____For Keeping Patient's Control Findings

_____For Keeping Patient's Prescription Information

_____All of them

**16.** Why do you prefer using computer-based pediatric software over other traditional methods (text card-based, patient ledger, etc.) of patient record keeping?

____Provides time efficiency

____Makes it easy for keeping archives

____Helps Keeping Office Supplies Expenses at the Minimum Level

____Provides easy reporting

____All of them

____Other: (Please specify)

**17.** What type(s) of eases does your pediatric EMR software provide?

____ Allows me to use time more efficiently

____Makes it easy for me to communicate one-to-one with the patients

____Makes routine processes such as report generation, invoicing, etc. easy

**18.** What can be done in terms of enhancing the capability of the pediatric EMR software that you are currently using? (Please rate each choice according to its individual importance. Extremely important = 1.....Not important = 5)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Can be put on the internet | __ | __ | __ | __ | __ |
| Can be made more user-friendly(Graphical growth curves, etc.) | __ | __ | __ | __ | __ |
| X-ray, MR, CT and EEG Results can be sent to the system electronically over the internet | __ | __ | __ | __ | __ |
| Laboratory Test Results can be sent to the system electronically over the internet | __ | __ | __ | __ | __ |
| Prescriptions can be printed out automatically by the system | __ | __ | __ | __ | __ |

***19.** Do you perceive internet and electronic communication (e-mail, video-conferencing systems, electronic data interchange) as the most important communication medium of the future?

____Yes ___No

***20.** Would you like to use the proposed web-based (internet-based) patient follow-up software which could be customized for your business needs?

____Yes ___No

**21.** If your answer for question 20 is "YES", what feature(s) make(s) the proposed web-based patient follow-up software attractive for use?

____Pediatrician being able to access patients' information anywhere, anytime and in any format.

___Patient data being kept on a secure ISP server.

___Maintenance and virus scanning of patient data being done by the ISP

___Pediatrician being able to backup patient data whenever he/she wants

___Patients being able to access their medical information anywhere, anytime, and in any format.

___Laboratories being able to send patients' laboratory test results electronically over the internet and the pediatrician being able to view results simultaneously.

___All of them

**22.** If your answer for question 20 is "NO", in what way(s) do you believe the proposed web-based patient follow-up software is unattractive?

____No time to spend on computers/new technologies

____No prior experience on using pediatric EMR software of any type

____I find it unethical to store patient information on the internet environment

____Potential virus and hacker attacks on the internet environment

____Slow internet connection speed

____Potential risk of losing patient data

____All of them

**B-2.** Original Survey (in Turkish)

# *SAĞLIK SEKTÖRÜNE İLİŞKİN YÖNETİM BİLGİ SİSTEMLERİ UYGULAMASI*

## İZMİR METROPOLÜNDEKİ ÖZEL ÇOCUK HEKİMLERİNİN ELEKTRONİK HASTA TAKİP PROGRAMI KULLANIMINA İLİŞKİN BİR ARAŞTIRMA VE WEB-TABANLI HASTA TAKİP PROGRAMI MODELİ ÖNERİSİNİN İNCELENMESİ

Bu anket öncelikli olarak çocuk hekimlerinin muayenehanelerinde elektronik hasta kayıt sistemlerini kullanımı ve önerilen web-tabanlı EHTP modeli hakkındaki düşüncelerine yönelik bilgileri toplamak amacıyla hazırlanmıştır. Bu anketten elde edilen sonuçlar sadece araştırma amaçlı kullanılacaktır. Ankete katılanlar tarafından verilecek olan bilgiler herhangi bir açıklama yapılmadıkça gizli tutulacaktır. Lütfen anketi doldurmaya zaman ayırınız. "*" işareti ile belirlenmiş olan her bir soru için en az bir cevap vermeniz gerekmektedir. Olabildiğinizce spesifik, objektif, ve doğru cevap vermeye gayret ediniz! Katılımınız ve sabrınızdan dolayı teşekkür ederim.

**"*" belirtilmiş olan soruları cevaplamanız gerekmektedir.**

* 1. Adınız ve Soyadınız?

* 2. Mezunu olduğunuz (ihtisasınızı aldığınız) üniversite ve anabilim dalı?

* 3. Uzmanlık Alanınız?

* 4. Muayenehanenizin bulunduğu ilçe?

* 5. Kaç yıllık çocuk hekimisiniz?

___0-1 yıl
___1-3 yıl
___3-6 yıl
___6-9 yıl
___9-12 yıl
___12-15 yıl
___Daha fazla

* 6. Kaç yıldır özel muayenehaneye sahipsiniz?

___0-1 yıl
___1-3 yıl
___3-6 Yıl
___6-9 Yıl
___9-12 Yıl
___12-15 Yıl
___Daha Fazla

* 7. Muayenehanenizde kişisel bilgisayarınız (PC) var mı?

___Evet ___Hayır

8. Bir önceki soruya yanıtınız "EVET" ise, muayenehanenizdeki PC'nizi en sık hangi amaca yönelik olarak kullanıyorsunuz?

___Hasta Bilgilerini Takip Edebilmek Amacıyla
___İnternet Kullanımı Amacıyla
___E-mail (Elektronik Posta) Okumak/Göndermek Amacıyla
___Dilekçe, Rapor ve Benzeri Dökümanları Yazmak/Arşivlemek Amacıyla
___Diğer:

9. 7. soruya yanıtınız "EVET" ise, bilgisayar tabanlı hasta takip programı kullanıyormusunuz?

___Evet ___Hayır

10. Bir önceki soruya yanıtınız "HAYIR" ise, hasta takip programı kullanmayışınızın nedeni/nedenleri nelerdir?

___Fiyatlarının uygun olmaması
___Kullanışlı olmamaları
___Bilgisayarlarla aramın iyi olmaması
___Hasta sayımın programa gereksinim duymayacak kadar az olması
___Eski alışkanlıklarımdan kolay vazgeçememden dolayı
___Hepsi
___Diğer:

**(11.sorudan 18.soruya kadar olan kısmı, Hasta Takip Programı kullanıyorsanız cevaplayınız!)**

11. Hangi firma tarafından üretilen hasta takip programını kullanmaktasınız?

___NETSIS
___LOGO
___ETA
___EGE BIMTES
___Diğer:

12. Kullanmakta olduğunuz Hasta Takip Programının üretici firmasını tercih etme nedenleriniz nelerdir?

___Güvenilir bir firma olması
___Kaliteli yazılımlar üretiyor olması
___Hizmet anlayışının beklentilerimi karşılıyor olması
___Fiyat politikalarının uygun olması
___Hepsi

13. Kullanmakta olduğunuz hasta takip programı hazır paket programı mı yoksa kişiselleştirilmiş yazılım mı?

___Hazır Paket Program
___Kişiselleştirilmiş Yazılım

14.Hasta takip programı içerisinde en sık yararlandığınız modül(işlev)/modüller(işlevler) hangisidir?

___Hasta Aşı Takvimi
___Hasta Gelişim Eğrileri
___Hasta Özlük Bilgileri
___Hasta Laboratuvar Tetkik Sonuçları
___Hastalık Bulguları ve Reçete Bilgileri
___Hepsi
___Diğer:

15. Hasta takip programını hangi amaca yönelik olarak kullanmaktasınız?

___Hastanın Kişisel Bilgilerini Saklamak için
___Hastanın Aşı Takvimini Saklamak için
___Hastanın Gelişimini Takip Edebilmek amacıyla
___Hastaya İlişkin Bulguları Saklamak amacıyla
___Hastaya İlişkin Reçete Bilgilerini Saklamak için
___Hepsi

16. Bilgisayar tabanlı hasta takip programı kullanmanızı diğer geleneksel hasta takip yöntemlerine(kağıt üzer nde, kayıt defteri,vb.) tercih etmenizin sebebi nedir?

___Zaman açısından verimlilik sağlaması
___Arşivleme işleminin kolaylaşması
___Muayenehane malzeme harcamalarımın minimum seviyede tutulmasının sağlanması
___Kolay raporlama imkanını sağlaması
___Hepsi
___Diğer:

17. Kullanmakta olduğunuz hasta takip programı işinizde ne tür kolaylıklar sağlamaktadır?

___Zamanımı daha verimli kullanmama yardımcı olmakta
___Hastalar ile birebir iletişimimi kolaylaştırmakta
___Raporlama/Faturalama gibi rutin işlemleri kolaylaştırmakta

18. Kullanmakta olduğunuz hasta takip programının işlevini arttırabilmek için ne/neler yapılabilir? (Lütfen her bir unsuru önem derecesi sıralamasına sokunuz. Çok Önemli=1.....Hiç Önemli Değil=5)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| a. Internet üzerine taşınabilir | ___ | ___ | ___ | ___ | ___ |
| b. Daha user-friendly hale getirilebilir (Büyüme Eğrileri grafik haline getirilebilir, vb.) | ___ | ___ | ___ | ___ | ___ |
| c. Rontgen, MR, BT Sonuçları sisteme otomatik olarak gönderilebilir | ___ | ___ | ___ | ___ | ___ |
| d. Laboratuvar Sonuçları sisteme otomatik olarak gönderilebilir | ___ | ___ | ___ | ___ | ___ |
| e. Reçeteler otomatik olarak sistem tarafından yazdırılabilir | ___ | ___ | ___ | ___ | ___ |

* 19. İnternet ve elektronik haberleşmeyi (elektronik-posta, tele-konferans sistemleri, elektronik veri aktarımı) geleceğin en önemli iletişim aracı olarak görüyormusunuz?

___Evet ___Hayır

* 20. Kişiselleştirilebilen web-tabanlı(internet-tabanlı) hasta takip modelini kullanmak istermiydiniz?

___Evet ___Hayır

21. Eğer 20. soruya yanıtınız "EVET" ise, internet tabanlı hasta takip programını kullanmayı cazip kılan özellikler nelerdir?

___Hasta bilgilerine dilediğim anda, dilediğim yerden, dilediğim şekilde ulaşabilmem
___Hasta verilerinin güvenli bir internet hizmet sağlayıcısı sunucusunda tutulması
___Hasta verilerinin bakımının ve virüs taramalarının internet hizmet sağlayıcısı tarafından yapılması
___Dilediğim zaman verilerin back-up (yedekleme) işleminin gerçekleştirilebilmesi
___Hasta sahiplerinin, hasta bilgilerine diledikleri anda, diledikleri ortamdan, diledikleri şekilde erişebilmeleri
___Hastalara ait laboratuvar tetkik sonuçlarının otomatik olarak internet üzerinden gönderilebilmesi ve anında görüntülenebilmesi
___Hepsi

22. Eğer 20. soruya yanıtınız "HAYIR" ise, internet tabanlı hasta takip programını ne yönden sakıncalı buluyorsunuz?

___Bilgisayarlara/Yeni teknolojilere ayıracak vaktimin olmaması
___Daha önceden hasta takip programı kullanım deneyimine sahip olmamam
___Hasta bilgilerinin internet ortamında bulundurulmasını etik açıdan doğru bulmuyorum
___Internet ortamındaki virüs ve hacker tehlikesi
___Internet bağlantılarının henüz istenilen düzeyde hızlı olmaması
___Hasta verilerinin kaybolma riski
___Hepsi