

# Health Care Implementation by Means of Smart Cards

Dr. Magdy E. Elhennawy  
High Institute of Computers and Information Technology,  
Computer Dept., El-Shorouk Academy,  
Family Card Project Consultant,  
Ministry of State for Administrative Development,  
Cairo, Egypt,

Dr. M. Amer  
Higher Institute for Specialized Technological Studies, Future Academy,  
Information System Dept., El-Future Academy,  
Cairo, Egypt,

A. Abdelhafeez  
Ministry of State for Administrative Development, Project Manager,  
Cairo, Egypt,

## Abstract

Smart card technology is a reliable and proven solution that has had decades of use in various industries and is now making its mark on healthcare. It is portable, secure, and can hold health information. In this research, the smart card has been introduced in a new usage; it is used to control the referral process. It holds the control parameters that link between the referring entity and the referred entities. This leads to control the management of the claims in a timely and correct basis. The smart cards technology, in this research, have been used for: verifying citizen eligibility, registering recent citizen medical visits to family medical units as well as the corresponding visits to contracted providers besides the link between them, reporting, and facilitating claim management. Accordingly, the usage of smart cards in this way will add. The research allows remarkable improvements in the healthcare service provision.

**Keywords:** *Smart card technology, Healthcare using smart cards, smart healthcare cards.*

## 1. Introduction

Healthcare is seeing a steady and increasing dependence on information technology that is rapidly transforming the practice of medicine and the delivery of care. Technology is an ever-changing and evolving aspect of modern business. In healthcare, most agree that the use of information technology is essential to achieving many of the milestones critical needs of the healthcare reform. Three primary drivers are increasing the use of technology in healthcare, namely: 1) The need to lower costs and allows administrative efficiencies, 2) The need to improve patient outcomes and enhance physician and patient relations, and 3) The need to meet increasing privacy, security and identity concerns.

Smart card technology can provide innovative, practical and cost-effective solutions in healthcare domain. In this research, we will introduce the smart card technology as

a tool to link between cycles of health care, including the on-line delivery of claims for appropriate and timely claims management.

This research introduces the subject and objective of the research, this section. In Section 2, smart card technology standards are introduced. In section 3, various smart cards applications are surveyed, in Section 4, how smart cards can improve healthcare is discussed, in section 5, the research contribution for how we can adapt smart cards to facilitate claims management is introduced, in section 6, we analyze our proposal and a sample of assumed results are presented and commented, and finally, in section 7 the conclusions and future work are stated.

## 2. Smart Card Technology Standards

Smart cards first emerged onto the worldwide stage in 1974, when Frenchman Roland Moreno patented a smart card to use as a payment source for a telephone call. Since then, smart cards have found their way into virtually every industry, including healthcare [1].

Smart cards are essentially miniature computers without display screens or keyboards containing an embedded integrated circuit (or chip) that can be either a secure microcontroller with internal memory or simply a memory chip. Usually, microcontrollers contain a microprocessor and different kinds of memories: RAM, ROM, and EEPROM. The chip is a powerful minicomputer that can be programmed in different ways. It contains some sensors (like light sensors, heat sensors, voltage sensors, etc.), which are used to deactivate the card when it is somehow physically attacked [2]. Some smart cards hold various types of information in

electronic form and protect the information with sophisticated security mechanisms; others provide a key that unlocks a particular database on a particular server. Because of their portability, inhibited security features and size, smart cards provide an ideal solution for secure data exchange.

Smart cards can perform many functions, such as storing data, making calculations, processing data, managing files, and executing encryption algorithms. Smart cards make possible sophisticated and portable data processing applications and are far more secure and reliable than passwords or magnetic stripe ID cards [3][4].

Standards help ensure smart cards can be read by any retailer equipped with a smart card reader [1]. Smart objects, in general, need to fulfill a set of requirements such as controllability, maintainability, scalability, interoperability, security, and reliability [5]. Smart card technology conforms to international standards ISO/IEC 7816 and ISO/IEC 14443.

### **3. Smart cards Applications**

Because of their size, flexible form factors and relatively low cost, smart cards are ideal for applications in markets where personal identity, privacy, security, convenience, and mobility are key factors [6].

In 2008, 5.045 billion smart cards were shipped worldwide—an impressive 13.2% increase over the 2007 figure of 4.455 billion—with about 15% of these cards entering the U.S. market [7]. Smart cards are deployed all over the world for personal identification, playing a critical role in logical and physical access control systems. Across the globe, public and private sector organizations are recognizing the security and efficiency of using smart card in identification applications. Smart cards are used in a wide variety of payment applications, and extensively in the telecommunications industry all over the world.

One of the today's applications is the health care. Within the U.S. healthcare industry, the Health Insurance Portability and Accountability Act of 1996 (HIPAA) is driving the use of smart cards for both patients and providers to improve the security of healthcare IT systems and protect the privacy of patient information [8]. Healthcare organizations worldwide are implementing smart healthcare cards to support a variety of features and applications.

### **4. How Smart Cards Can Improve Healthcare**

Over the past few years, smart card use in the U.S. healthcare sector has grown significantly and recently has used smart cards to upgrade level of significance. Current programs focus on patient identification: streamlining admissions, managing payments, and

moving patient data from point to point. Four needs have driven smart card use in health care to date. They are identification and patient authentication, matching patients to their particular data, synchronizing data from disparate sources, and security and access control.

Numerous benefits devolve to different healthcare stakeholders from using smart cards. Employing smart card can help in healthcare cost reduction, help in improving stockholders revenue, control fraud and misuse, and other features.

#### **4.1 Cost Reductions**

A major advantage of using smart cards in healthcare is the reduction in costs that results from improving the efficiency of handling medical and administrative information, which, on the other hands, increases the quality of service.

Smart cards can be integrated with healthcare systems in such a way that it can reduce cost such as: reduced administrative time and cost by automating patient identification, reduced duplication of records, fewer errors and adverse events through the use of accurate and timely information, reduced number of rejected claims and faster payments, by using accurate patient, reduced claims processing costs through real-time adjudication of claims and insurance coverage verification information.

#### **4.2 User Identification, Authentication, and Authorization**

Identification, authentication, and authorization are the pillars of security in the electronic world. Recently, based on various techniques, many password authentication schemes using smart cards have been proposed by some researchers. These schemes can allow a legal user to login to remote server and access its facilities [9]. Accordingly, entity authentication is one of the most important security services that can be applied by smart cards. It is necessary to verify the identities of the communicating parties when they start a connection [10].

In addition to the financial loss incurred by healthcare fraud, fraud poses tangible health risks for patients whose records are compromised. With the creation of large clinical data exchanges and the ready availability of information on the Internet, all system users need to be accurately identified, and properly authenticated before being allowed to access information. And finally, all individuals must have the appropriate authorization to access medical data and initiate particular transactions.

Smart cards can provide positive identification of the patient at the registration desk, by allowing personnel to be verified, however, facilitate rapid identification of a patient arriving at an emergency room and rapid retrieval

of lifesaving information about medical history, recent tests, treatments, and medications. This critical information can be stored on the smart card chip or the smart card can provide secure access to data stored elsewhere.

Using a smart card to verify patient identity can offer healthcare providers the following benefits: 1) Make it easy to link patients to the correct medical records, 2) Reduce the creation of duplicate records, 3) Reduce the potential for medical identity theft and fraud, 4) Improve the efficiency of the registration process and the accuracy of data, and 5) Improve the revenue cycle and reduce the number of denied claims.

Studies have found that on average, 5%–15% of a hospital's medical records are duplicated or overlaid [11]. The more duplicates there are in a system, the higher the rate of new duplicates. The growth rate becomes exponential with the size of the patient database [12].

So, by implementing smart card technology as part of the admission and registration process, an institution can reliably identify its patients, increase the accuracy of data capture, optimize patient throughput, accurately link patients to their medical records, verify eligibility, and ultimately improve patient experience and satisfaction.

#### 4.3 Claims Denial and Revenue Capture

Two of the most common reasons for claims denials are incomplete demographic information and incomplete insurance information, which can cost a healthcare institution millions of dollars in lost or delayed revenue. Most healthcare CFOs are acutely aware of the high cost of reviewing and resubmitting old claims and the revenue lost because of cumbersome claims processing, including detailed chart reviews and outreach to patients and physicians for additional information.

The healthcare revenue cycle is highly dependent on the front-end registration process, which drives much of the downstream claims process. Studies estimate that 50%–90% of claim denials could be prevented by securing accurate patient information at the front desk [13][14]. According to a study by PNC Financial Services, one out of five claims submitted is delayed or denied by insurers. Smart card technology can greatly improve the accuracy of routine data capture. Instead of transcribing information from paper forms and increasing the risk of human error, smart cards can access or provide insurance information, demographics and other patient information, reducing claim denials and increasing cash flow.

#### 4.4 Immediate Access to Lifesaving Information

Everyone in the continuum of healthcare, from ambulance crews to emergency room personnel to physicians and nurses, needs immediate access to accurate medical information such as a patient's medical history, allergies, prescriptions, and over-the-counter drugs. According to a recent study conducted by the Boston Consulting Group, as much as 40% of patient information is missing when needed by a medical professional for proper care [15]. A report published in the *Journal of the American Medical Association* found that adverse drug interactions and medical errors result in an estimated 225,000 deaths per year [16].

Smart cards carried by patients allow immediate access to vital information and information from other points of care that otherwise might not be available. Even when hospital records are not available, information stored on a smart card or accessed from the smart card with a portable reader provides an easy way to triage patients in emergency and disaster situations. Such information can be accessed from an ambulance en route to a hospital or in the field as part of disaster response. Medical information stored on a smart card can be accessed even when computer networks and power lines are inoperable [17].

#### 4.5 Healthcare Fraud, Abuse, and Misuse

The National Health Care Anti-Fraud Association (NHCAA) estimates that 3% of USA annual healthcare pending (\$68 billion in 2007) is lost due to healthcare fraud [18]. Other estimates by Government and law enforcement agencies place the loss as high as 10% of USA annual expenditure, or \$200 billion, and growing [19].

The impact of healthcare fraud and abuse reaches far beyond cost; quality of care is compromised by false or inflated claims. The health and well-being of a patient are jeopardized when the patient is exposed to unnecessary and dangerous tests and procedures. Some patients have become "paper pawns" when fabricated histories add erroneous information to their medical records. Fraud can also threaten patients' future insurability. Smart cards can be used to secure access to electronic medical records. Implementing strong authentication within a medical facility will not eliminate but will certainly reduce the risks that personal health information is compromised.

#### 4.6 Support for a National Health Network

Federal- and private-sector initiatives have established a framework for the creation of the Nationwide Health Information Network (NHIN). The main goal of the NHIN is to develop a scalable and secure system for exchanging healthcare information on a national level in USA.

A highly reliable identity management infrastructure is critical to the success and viability of a national network. Smart card technology can play a critical role in this infrastructure. Smart cards can be used to positively identify patients at the point of care and securely track their access to care across multiple providers. The card can be used to aggregate all medical record numbers for a patient as the patient receives care. This can greatly facilitate linkages with local data exchanges and regional health information organizations (RHIOs). Using the smart card in this way greatly improves the fidelity of the linked medical records and reduces reliance on statistical methods for matching patients to medical records, which can propagate errors. Smart cards would also provide access control for those viewing the medical records on the network.

Other advantages to using smart cards as part of a national network are that fraud and abuse can be greatly curtailed, and medical identity theft would be more difficult if an identity credential were part of the process [20]. Additionally, the smart card can be used as a security token for patients to access their personal health records online and can promote greater patient involvement in health and care management.

## 5. Adapting Smart Cards to Our Solution

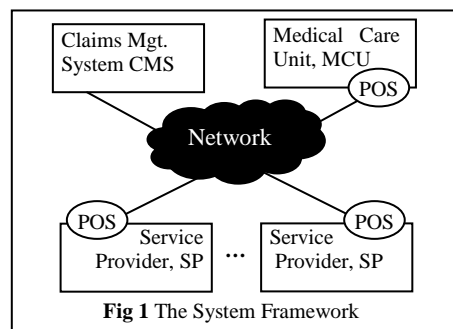
Ministry of State for Administrative Development, MSAD, has proposed, designed, and implemented a pilot for the achievement of the health care systems using smart cards, with the cooperation with Health Insurance Organization. The following is the approach of this pilot.

### 5.1 System Framework

Smart card has been used as an efficient tool to deliver services. In our research the use of smart cards has extended to cover the eligibility verification starting from check-in in the admission desk, the control of the referral process, as well as facilitating claims management. The idea of the research is based on using the smart cards to hold the control parameters that link between the referring entity and the referred entities, which leads to control and manage the claims management in a timely basis more correctly.

Our solution is based on the fact that the patient starts his medical course by visiting his Medical Care Unit, MCU. The population has been divided geographically into groups, each has assigned to a specific MCU. The MCU is typically a medical unit, prepared with medical specialties' doctors, labs, radiologists, and a pharmacy, each with limited capabilities. It has an automated Clinical Information System, CIS. In this unit, the patient would be investigated, and his prescription can be defined. If his status needs, the prescription may define other Service Provider, SP to be referred. SP may be other consultant doctor, test lab, radiologist, for further

investigation or pharmacy to receive medicine. However, patient should visit the referred SP and may come back to the MCU for finalization of his case. The patient medical course starts in MCU, then various SPs, and come back to MCU.



Each MCU is equipped with point of sale, POS and have a smart card. Each SP is equipped with POS and also has a smart card. The CMS, referred to sometimes as Payer, is equipped with a server with a proper specifications. The system is supported a medical database, called the Family Medical Database, FMDB. The eligibility status of the population is registered on FMDB, managed by CMS, and continually updated. The service providers, various system codes, any other needed data, are stored on FMDB.

Each eligible citizen have a smart card (basically, one for the family holder and may be for family individuals if requested). Eligible citizen smart card will be used to verify the citizen eligibility as well as to register the citizen medical visits, then to control eligibility of such visits with the CMS. Smart card, issued for eligible citizens, will contain, for healthcare management, the needed data items such as: citizen national number, NID, service eligibility status, related health insurance law, list of medical visits together with the associated data of the service provided, and claims data needed to CMS. Smart card, issued for MCUs and SPs, will be used to start his POS daily work, and do the needed system administrative work. Initially, the eligibility status will be stored on the FMDB, as well as patient's smart card. Any changes to this status will be sent from FMDB by means of CMS to related MCUs' and SP POSs and accordingly installed on the patient's card automatically whenever he is going to receive the service.

When the patient visits the MCU, his eligibility will be verified against the value stored on the smart card by comparing the MCU ID registered on the smart card with that registered on the POS of that MCU. In MCU, if the patient has been referred to other SPs, their IDs will be stored on the patient smart card. This will allow the SPs' system to verify the eligibility of this patient by



comparing the SPs IDs registered on the smart card with that registered on the POS of that SP. In a daily basis, MCU' and SP' POSs will send the list of medical visits and their associated data to CMS to allow claims management. The CMS will communicate with FMDB for the updating of related data and the service provision status. **Figure 2** shows the proposed system interactions.

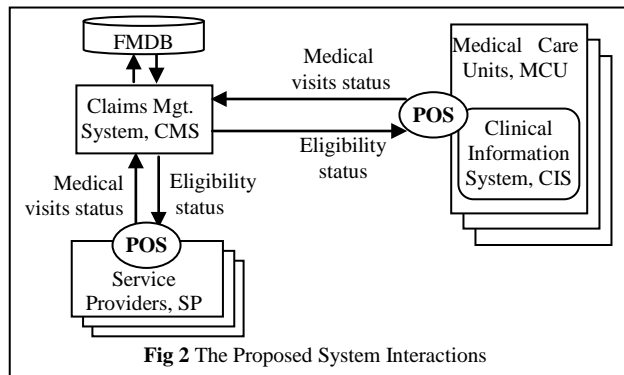


Fig 2 The Proposed System Interactions

### 5.2 System Preliminaries

Health care packages provided to patient are defined. Each package contains a set of elementary medical services. Each of them is distinctly coded and priced. Elementary medical services cover all medical possible provided cases. Sometimes, a patient may need medical services that are not defined inside his eligible package. SP might be obliged to provide such service, in some circumstances, to save patient life. The rules governing these exceptions will, also, be pre-defined properly.

All elementary medical services are priced, eventually, each total package is priced. However, the provided elementary services are identified and can be measurable. Accordingly, the medical services provided to a patient can be priced and measurable.

Health care packages and their internal elementary services provided to patients can be defined as follows:

**Package #1: ..... code: 000000**

Elementary medical service #1: . code 000, price: 000,

Elementary medical service #2... code 000, price: 000,

...

Elementary medical service #n: .. code 000, price: 000,

.....

**Package #m: ..... code: 000000**

Elementary medical service #1: . code 000, price: 000,

Elementary medical service #2... code 000, price: 000,

...

Elementary medical service #v: .. code 000, price: 000,

Where n, .. v are the number of elementary services in individual packages, and m is the number of packages provided by the system. International codes can be used.

For other cases that are not covered by international codes, local codes can be designed and used. The elementary service can be identified by composite key constituting package code and service code.

When a patient receives his services, a transaction record is formed by the SP's electronic system, and sent electronically in a daily basis to the CMS. The transaction is composed of the following data items: date/time, SP's identification, and provided services data items. Provided services data items are of two categories, services inside the package and services outside the package code. Services outside the package will be provided to the patient by SP in emergency cases only and according the pre-defined rules. The classification into these two categories is done by the system according to eligibility status. When CMS receives a patient transaction from SP, the services inside eligible package can be differentiated from services outside the package. However, inside services can be calculated and outside services can be controlled and calculated.

The smart card data can be: Patient NID, Patient eligibility, IDs of allowed packages, Referred visits (Consultants, Test lab, Radiology, Physical treatment, and Pharmacy). Referred visits will contain its ID, status, and date/time, where: status means whether the visit and the service provision have been done or not yet, date/time is the date and time of performing the visit. Figure 3 the proposed system interactions

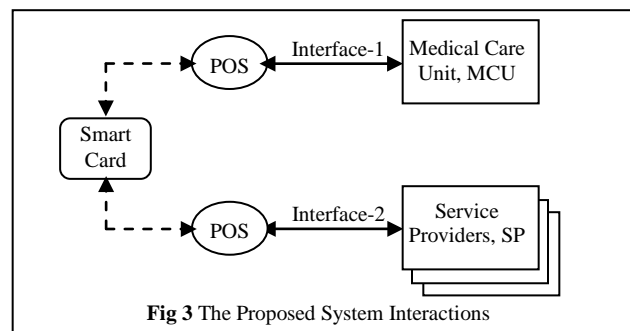


Fig 3 The Proposed System Interactions

Interface-1 is responsible for: verifying the patient eligibility in MCU, storing the type of referrals visits, and identifying and registering the referred entity. The identifying and registering the referred entity is done by the Case Management Office (CMO). Interface-2 is responsible for verifying the patient eligibility in SPs, and storing the status of referrals visits together with the date/time. Enough data about the referrals will be stored.

All referred visits have been stored in batches inside the service providers' POS's and batches are sent to CMS, electronically, in a daily basis.

### 5.3 The Proposed Blocks of the Healthcare

Accordingly, the proposed healthcare system comprises three basic components, namely: 1) Clinical Information System, CIS, and POS application in MCU 2) POS applications in Service Provider's premises, and 3) Claims Management system CMS. The three components are linked together through network. The smart card, as will be described below, is used to link patient's visits to various referrals with initial visit to family medical unit.

The CIS is an electronic application that can manage the registration of the patient, follow-up the patient medical visit in MCU. At the end of the day, the patient record may be of one of two cases: 1) Closed case: in which he receive medicine from MCU's pharmacy and close his case, or 2) Open case: in which types of other consultants for further medical investigation, labs, radiologists, or pharmacies to receive other medicines have been referred. The referrals will be registered on the patient smart card by means of the POS application.

Accordingly, patient will visit the referred SP. Eligibility will, first, be verified using patient smart card and his POS application, and if valid he will receive the appropriate service. The status of service provision will be stored on the card and sent to CMS, in a daily bases.

The claims management system basic role is to manage the periodical settlements among claims received from various system service providers. To be appropriate, it should receive accurate claims from various service providers. CMS receives from SPs and MCU, electronically, the claims data which are: Patient NID, Patient eligibility, IDs of allowed packages, Referred visits (Consultants, test lab, radiology, physical treatment, and pharmacy). Referred visits will contain its ID, status, and date/time, besides the SP IDs. In case provided service code indicates a medicine delivery from outside pharmacy, the medicine's codes are provided. Such information allows CMS to manage efficiently, in daily bases, the claims. The daily claims management allows accurate computation, minimize expected errors, prevent claims management delay, and allow timely stockholders revenue.

The use of smart cards will facilitate the roles of the above components, and makes them work properly. Smart cards will store appropriate data about the patient eligibility, case status, defined referrals, result of each referral visit, and last status after finally closing the case in the MCU. On the other hand, a periodical exchange of the referral claims, by means of distributed POSs, will be sent to CMS for appropriate settlements. The usage of the smart cards can, in our proposal, control the patient

eligibility, control the referral visits, and allow accurate data exchange by the cards.

### 5.4 Benefits of the proposed System

The combination between smart cards and information technology to manage the claims in healthcare, according to our research, leads to a set of benefits. First: since the eligibility and related package services are stored on the card and periodically/electronically updated; the correct verification of the patient service eligibility can be reached. We are sure the patient receives correct and eligible services. Second: since health care packages and their internal services are defined clearly, and coded correctly, the correct and precise pricing of individual health care services can be defined. This leads to the fact that the pricing of the individual claims are verifiable and can help the correct claim management. Third: since the exceptions that may happen during the service provision, and their application rules are clearly defined, when such exceptions happen during service provision adding additional medical services to the approved packages, it will be legal to add such exceptions. This will facilitate the claims management. Fourth: under the above circumstances, the electronic exchange of claims between service providers and claims management system will facilitates the correct, speedy, and verifiable claims settlement. This will compensate a loss and denial in claims for service providers about 20% as previously stated (refer to Section 4.3 out of five claims submitted is delayed or denied). Fifth: since health care services are timely registered in the system database, a transactional database will be built. This leads to the fact that all provided health care services and their related data (date, time, service provider ID, ...) will be available for further analysis, investigation, and inspection. A lot of conclusions can be reached and forecasting can be very useful benefits to system.

### 6. System Analysis and Simulation Results

A comparison between the manual and expected electronic systems has been assumed. A random number generator has been used to assume claims data received from system SPs to simulate the system operation. The applied time frame was 6 months from January to June, 2010. The assumed results have been generated under the following assumption: 1) the number of denied and delayed claims cannot exceed 20% of the total claims according the figures stated in Section 4.3, 2) the number of delayed claims will be greater than denied one by 3% as the delay will be more due to the manual intervention in the above system, 3) delayed claims in the above system will last not more than 3 months, 4) the delayed claims will be 100% for the first month, 30% for the second month, and 10% for the third month. **Annex 1** shows the assumed data together with the calculated results.

It is clear that the difference between the actual received claims differ from the valid claims because of the paper wise management of the claims, and the manual exchange of claims before applying the proposed system.

As our research will control the claims management processing, the stated above denied and delayed claims will be prevented. **Figure 3** shows the total number of received claims against total number of managed claims in previous system, noting that in our proposed system the managed claims will be the received claims. **Figure 4** shows the total number of received claims against total number cumulative number of denied in addition to delayed claims previous system.

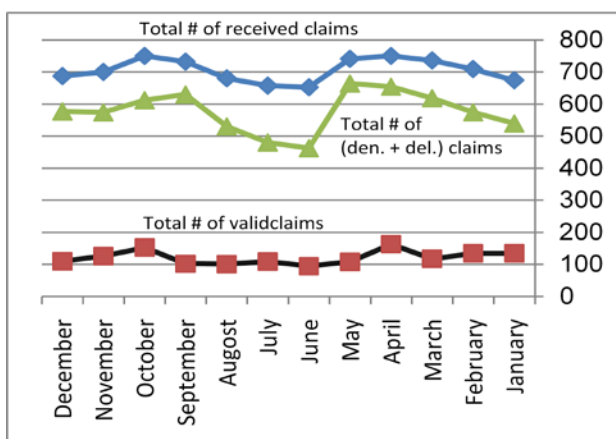


Fig 3 Total # of Received Versus Managed Claims in Previous System

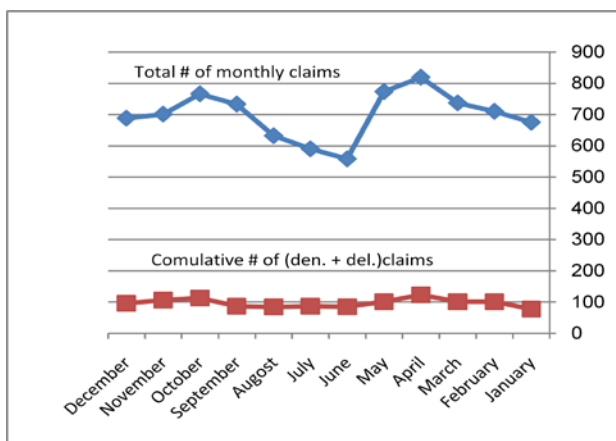


Fig 4 Total # of Received Claims Versus Cumulative # of Den. + Del. claims

According to our assumption, 1% of the electronic claims in proposed system will be lost; however the proposed system still saves in claims management.

### Conclusions and Future Work

Smart cards provide a valuable and trusted tool for identification and for the privacy and security of electronic information. In this context, smart cards offer extraordinary value to the healthcare sector. They provide a means to using technology to save time, effort, resources, and, most importantly, lives. Moreover, in our research, it is used for claims management. There are clearly demonstrable returns on investment gained by leveraging smart card technology.

In the research, the use of smart cards proof facilitating the following: 1) Verifying patient eligibility in both MCU and SPs, 2) allowing the patient eligibility continual updating on his smart card remotely, and 3) facilitating the claims management. The usage of smart cards technology in our research for health care application, for claims management has proofed the following: 1) proof the citizen eligibility, 2) registering the citizen medical visits to family medical units as well as the visits to contracted providers, 3) reporting, and 4) Facilitate conducting claim management. Accordingly, we feel the usage of smart cards in this tender will add.

The topic has not yet closed, a lot of future work need to complete the view. One of the important future work is to unify health record, from point of view of contents and storage location. Second, we should unify medical codes, covering the doctor's specialties', surgery operations, and other codes that need to be applied. Third, it is needed to create coding system to medicines. It will be a big contribution if the medicines have been coded as well. A simulated results has been proposed, analyzed and proofed the objectives of the proposed solution.

### Appendix: System Analysis and Simulation Results

The data stated in **Table 1** contains the assumed numbers of received claims during year 2010 together with the percent of delayed and denied claims, according to our assumption. The corresponding denied and delayed claims have calculated according to above assumptions. In **Table 2** the corresponding delays of claims over three months have been calculated showing the impact of the number of claims on the following months.

Table 1

Month	Tot # of claims	% monthly of Den.+ Del.	Total # of Den.+ Del.	Total # of denied claims
January	675	20	135	57
February	710	19	135	57
March	737	16	118	48
April	819	20	164	70

May	773	14	108	43
June	558	17	95	39
July	590	19	109	46
August	632	16	101	41
September	733	14	103	40
October	766	20	153	65
November	701	18	126	53
December	688	16	110	45

Month	Total # of delayed claims	# of Delayed in 1st month	# of Delayed in 2nd month	# of Delayed in 3rd month
January	78	78	23	8
February	78	78	23	8
March	70	70	21	7
April	94	94	28	9
May	66	66	20	7
June	56	56	17	6
July	63	63	19	6
August	60	60	18	6
September	62	62	19	6
October	88	88	26	9
November	74	74	22	7
December	65	65	20	7

Table 2

	Jan.	Feb.	March	April	May	June
Total # of Monthly Claims	675	710	737	819	773	558
Cumulative # of Den. + Del. Claims	78	101	101	123	101	85

	July	August	Sept.	Oct.	Nov.	Dec.
Total # of Monthly Claims	590	632	733	766	701	688
Cumulative # of Den. + Del. Claims	87	85	87	113	106	96

**Acknowledgment**

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**shraf Abd El-Hafeez** is working as health project manager in MSAD, and has worked in the domain of hospital management information system, information technology, and education with experience about 22 years in IT industry (business & technical).



**Magdy El-Hennawy** is a lecturer in the Higher Institute of Computer Science & Information Technology, El-Shorouk Academy, and in the same time working as a consultant in the family card system in MSAD. Before and since 1978 working as manager of SW development and maintenance center specialized in mission critical SW systems development.

Before he was working in that place as deputy manager, chief of the system engineering team. Working as a team manager in the system analysis, design and implementation of SW systems, at the same time. He has researches and has taught courses in various subjects.



**Mohamed Amer** is lecturer in the Higher Institute for Specialized Technological Studies, Future Academy. He has worked in several positions such as maintenance & quality, crises management, info. system development. He has some researches and has taught a sort of courses in various places.

He is interested in Computer networks including Wireless Sensor Networks, Security in Computer Networks and Satellite Communications.