Designing smart health CARDS insured and linked to the citizens' biological identity

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Abstract

The smart health card offers many services that the regular identity card cannot accommodate, such as: illness history of citizens, dispensing drugs, allergies to certain drugs, etc., and the healthy card is provided by governments, companies or medical associations for certain fees to provide health insurance service easily and quickly. It is applied to private or public health insurance and carries the names of the citizen' parents, his marital status, his wife's name and children and his personal photo. In case of any accident that might happen for the person, it allows the permission to treat and dispense medicines to the citizen. This means that it is not limited to health insurance, but can be extended to other services such as pharmaceutical services, salary services, pensions, etc. The problem of the research is the absence of an updated health care insurance card system for the Egyptian citizen, which can register all his data, and until now a regular card is used in many governmental places that does not contain details about the health status of the citizen. This research aims to create an integrated database system to manage the health insurance data of citizens by means of a secured biometric smart card and improvement of the levels of security of the healthy card by providing convenient and secured identity authentication using secured smart cards.

Key Words:

biometrical - Card Application Management System (CAMS) - personal information- chip- security features.

Introduction:

Health insurance is a vital service that provides medical care to a large sector of Egyptian society; this service is provided by a paper card and can't carry sufficient data on a citizen's medical and pharmaceutical history or accurately describe his state of health, history of illness and medication.

According to these problems, it's important to serve a smart card with all the data needed to help a doctor to diagnose properly and administer the appropriate drugs that don't conflict with the patient's other diseases that the patient might suffer from or having allergy to certain drugs. This smart card is easy to keep anywhere because of its small size compared to the paper card and contains enough data of patient alongside medical services. Due to the importance of this smart card according to the information it carries, it must be secured by many levels whether visible or invisible, it can also supports using biometric features to ensure a person's identity.

DOI: 10.21608/mjaf.2019.19008.1365

Research Problem:

The absence of an updated health care insurance card system for the Egyptian citizen, which is registering all his data and until now paper card is being used in many governmental places which does not contain details about the health status of the citizen.

Research objectives:

1. Attempting to create an integrated database system to manage the health insurance data of citizens by means of a secured biometric smart card.
2. Improvement of the levels of securing the healthy Card by providing convenient and secured identity authentication using secured smart cards.

Research importance:

1. The health Insurance system needs an upgrade in Egypt to give the citizen good medical care services with suitable financial cost.
2. This upgrading of the system must be accomplished by using a new healthy smart card which should contain suitable secured features and all medical information about the citizen.
3. It's very important to serve a database of medical information about the Egyptian citizens.

Research methodology

This research follows the descriptive-analytical method and the experimental method to design health care secured smart card.

Literature Review

Designing and printing smart Biometrical ID Card.

The health care smart card design contains some basic data for the citizen:

- **Personal information**

This personal information is drilled and burned by laser beam; laser engraving is a technique of diagnosing polymeric documents. It is a digital printing method that can be described as inkless printing, since there is no pigment or color. It relies on the sensitivity of the plastic components to the intensity of the laser beams, and the burning of the plastic components into black carbon, which forms the pixels that produce the gray scale that makes up the image and data.

The laser beam used in diagnostic operations can work in two ways, the Raster mode, which is used to produce gray scale constituents of halftone images where the path of the laser beam is intermittent or pulsed and discontinuous. Unlike the other method, the method of curves Vector mode, which is used to write letters, and where the path of the laser beam is continuous. The laser can be used to produce data from letters and numbers with a distinctive texture Raised Laser Engraving by modifying the specifications of the laser beam used in the drilling process.

This personal information involves: Name / date of birth / marital status / insurance number / National ID / photo.

- **Material smart card**

There are many Polymer materials used to produce multiple types of smart cards, including:

PVC:

The least expensive material in the family of plastic materials, it is known to produce digital cards and life expectancy of this type of cards is between 3-5 years.

PET:

The PET properties have been improved and some modifications have been made to this material to obtain more quality specifications in the production of digital cards and to improve the durability characteristics of the card body and resistance to bending, as the new types withstand high temperature and very good resistance to solvents.

Teslin:

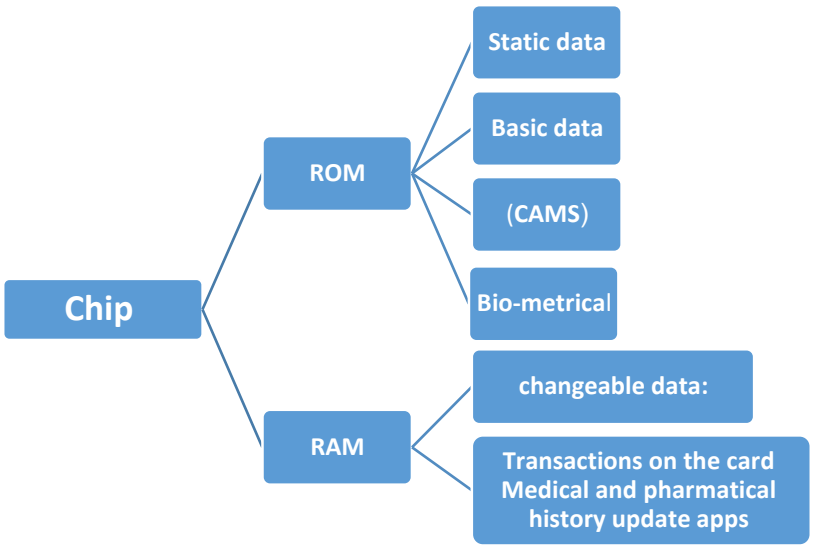
Teslin is an industrial porous material produced by the Japanese PPG Industrial Group. It is highly flexible, resistant to physical degradation and resistant to most chemicals and UV rays.

- **Electronic Chip**

The electronic chip is important because of the techniques provided the automated reading of the document and the possibility of verifying the contents of the document conclusively, in an easy and fast way.

Documents can be read automatically by more than one technique depending on the purpose of the card production, whether they are stored in printing methods such as barcodes, or if the information medium is added to the document such as magnetic tape or electronic chips.

Electronic Chip included: Contact Chip, Contactless Chip. They have storage capacity suitable for many applications. The chip also has the ability to change information, not only storage. The chip contains memory (RAM & ROM) to load the person's data and information, as shown below (see Fig. 1).



(fig.1) Memory types RAM & ROM

- **Visible and invisible security levels in smart card**

Security levels depend on software in which the system is programmed to perform mathematical equations to produce images or data associated with the card owner or card issuer.

Among the levels of security that can be produced on the smart health card:

1- First level:

(By naked eye verification)

Water marks: A watermark is an image or art form that appears visually and gradually from light to dark and three-dimensional when penetrated by visible light, that is, a physical change of paper fibers as a result of the rearrangement and distribution of fibers.

Optically Variable Inks (OVI): The latest in the world in the manufacture of ink security is the use of color change technology inks to give metallic color hints (metallic) so that the colors change inks when exposed to light from different angles, these inks mimic or imitate the iridescence and change color based on the angle of light. The vision of the color is changed whenever the viewing angle changes.

Guilloches: It's an intricate and complex design shaped like lines and graphs and rotating, circular curves and overlapping with each other through digital mathematics and complex geometric markers, this is done through special software produced by Parco, Java, or others.

Signature: Dynamic biometric data (signature) is based on a chronological order of movement of the pen that a person makes during the signature process.

The signature of a person is defined in two stages. The first stage relies on the virtual examination of the signature form. The second stage relies on the analysis of the signature dynamically through the speed of writing, the starting and ending areas, as well as the pressure and direction of the written jars.

The signature of people is digitally signed through simple devices based on pens and electronic surfaces from which to sign the signature.

Ghost Image with Letter Screen: One of the techniques of laser engraving on plastic materials depends on the formation of additional stealth image of the owner of the card. This image does not consist of normal grid points, but consists of accurate microscopic writings that cannot be clearly identified with the eye and need to be examined by a magnifying glass, then any type of variable data that are related to the card holder is added. This precise process is performed through a special program that analyzes the Halftone silhouette grades of accurate writings. The Halftone shadows are formed by changing the thickness of the letters and distributing them in the areas of the image.

2- Second level:

Fluorescent Mark color This technique can incorporate data that appear only in ultraviolet light, that are variable, and often correlate with the produced card data, where a dish of text can be created to appear to the naked eye in normal light conditions and adjacent to it the same hidden text that only appears through radiation.

Infrared marker: In this technology, data and information are stored digitally by mathematical equations within a formatted color system.

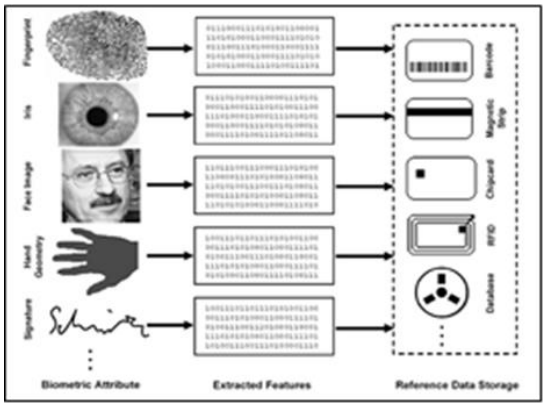
3- Third level:

- Micro print: It is a print of small letters that are not visible to the naked eye and can be seen through a magnifying glass
- Holograms: It is an important secured method in securing smart cards because of its brilliant effect, where the colors of the graphic elements change with changing angles.

- Barcode is a linear representation of machine-readable data. It is also a way to encrypt data, whether numbers or letters through a combination of lines and blanks of different dimensions, both lines and spaces are read through the barcode reader

4-Fourth level: with Biometric ID:

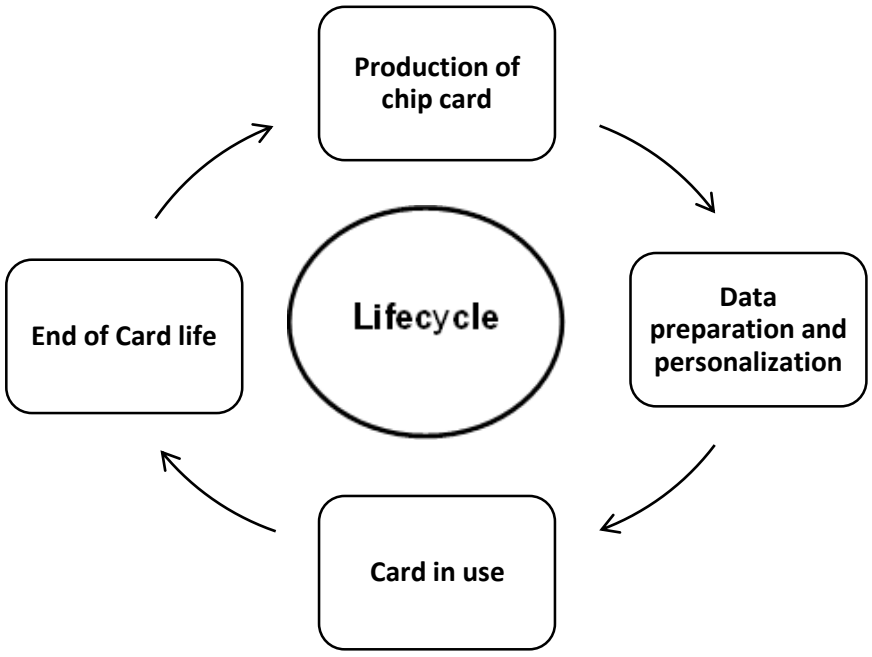
These systems encrypt and digitize the distinctive biometric techniques of a person through which persons can be quickly identified, revoke their operation through a software connected to a database of information about this person, and include (face print, finger print, palm print, Iris print etc.) (see Fig. 2).



(fig.2) Demonstrates the recording phase of various biometrics

Applications: system and database

The card is part of the system as it connects to a database, covering the entire health insurance system, which has access to the citizen profile in database. The card performs a function during card lifecycle (see Fig. 3).



(fig.3) Card lifecycle

Production of chip card:

Card Application Management Systems" (CAMS)

This system provides a secure operating environment by encrypting data and information.

The purpose of a card Application management system (CAMS) is:

1. Store and connect all necessary data for databases preparation.
2. Loading applications on smart card after issuance is possible by using CAMS.
3. By using CAMS, the person keeps track of loaded and used applications.
4. CAMS manage cards in the field and control the card usage.
5. Archiving orders which have been processed successfully.
6. Management and administration of card during the lifecycles of cards from issuance to revocation.
7. Archiving of historic data for statistical reasons or for card reissuance.
8. Preparation of the data for the personalization unit.
9. Processing the information and messages from other entities of the infrastructure which have access to the card.
10. Verification of compatibility of predefined rules and conditions.
11. Install connection to a trusted center.
12. Determine the security policy for the card.

Steps of Issuance the smart Card: (Card Defined steps):

1- Determine the ability of the card issuer to Manage: card orders - Application orders - Key generation orders - personalization issuance –authorization – revocation - card storage.

2- Process of definition and configuration for: CAD owner - application – password (pin) – lifecycle - target groups (hospital – pharmacy) - personalization data.

3- Card architecture: design- printing - security elements in the card.

4- (CAMS) management needs co-relation between: card manufacturer - card issuer.

CAMS infrastructure

- Card reader: Devices that can be connected to computers, and electronic devices for personal verification.
- Database :(archives and private data- control system- picture and other biometric archives).
- Fingerprint reader: The device works as a biometric fingerprint reader, where the device is able to capture the fingerprint and send it to the PC to match the fingerprint with the fingerprint database to see how reliable it is.
- Internet: An Internet is required to record updates on the database, and if there is no Internet, the system will record updates on the internal memory card until there is an Internet and the time required to transfer updates to the database should be available.

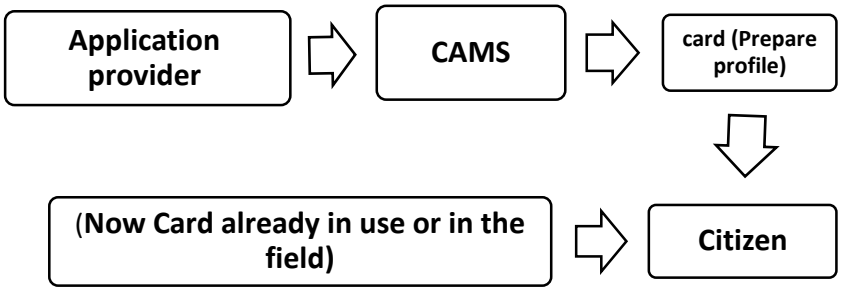
Data preparation and personalization: (Input data for CAMS)

The CAMS creates a profile for each citizen. This profile is defined in CAMS and is able to prepare and create data for each card.

According to card profile and rules order & personalization data will be stored in the CAMS data store, the data import or export is configurable via text files or by axes (XML)

Using CAMS applications (see Fig. 4)

1- List available applications for this client.
2- Update application on card.
3- Activate application on card.
4- De- activate application on card.
5- Delete application from card.
6- Change the application status.

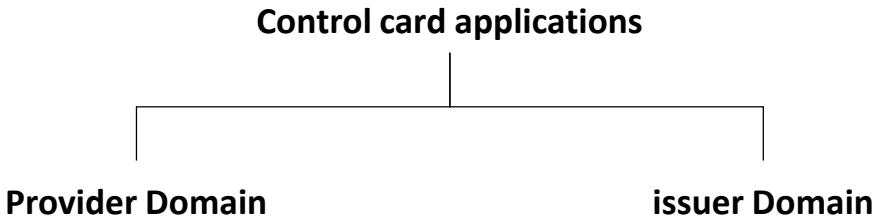


(fig:4) using CAMS applications

End of Card life

The card is automatically turned off by the end of the life cycle of the card which is written on the card, or turned off by the card application provider.

Control card applications (see Fig. 5)



(Fig 5): Control card applications

Secure information and Transactions within the database

1-Firewall make; application codes are separated.
2-Issuer security domain which supports security services such as key handling encryption.
3- Security domain: provide interface to applications to access security domain's services.
4- For security all application on the card must be loaded updated and deleted by the card issuer, security domain and all transactions are controlled by the card issuer.
or card issuer's applications are loaded, updated, deleted by cards issuer, security domain and application providers. Applications are loaded via the application provider but signed by issuer of the card.
5- All multi-application cards contain:

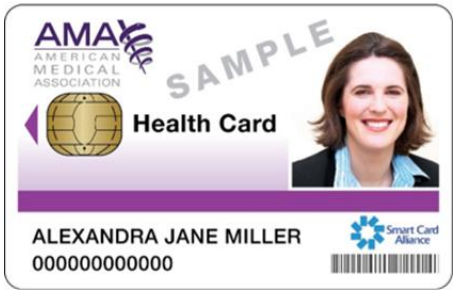
- Signature.
- Bio-matric.

- Home address stored only in the chip.
- Different PIN.

Some examples of applied smart cards to health services all over the world:

- **United States of America health card:**

The health card is a smart card of PVC material, photo of the owner of the card and information and personal data are printed on them (laser printer), also printed on it the logo of the American Medical Association, and also it contains a contact chip loaded with a person's medical data (see Fig. 6).



(fig.6) USA health card

- **European health card**

The health card is made of polycarbonate material, personal information of the owner of the card is printed on it, and also it contains a contact chip loaded with a person's medical data (see Fig. 7).

(fig.7) European health card

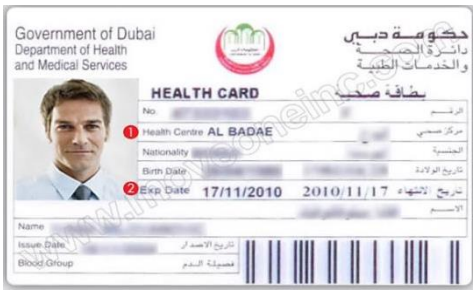
- **Smart health card in china**

The smart health card is a card made of polycarbonate material that have many levels of security printed on them which is as follows:
Watermark for the National Health Insurance logo, Guilloches lines in the ground and contact SIM card with medical information for the cardholder (see Fig. 8).

(fig.8) china health card

- **Smart health card in Dubai**

It is a health card made of PVC, a personal photo of the owner of the card and also a barcode stored on the medical data of the person are being printed on it (see Fig. 9.



(fig.9) Dubai health card

Experimental study

The experimental study deals with a set of proposed designs for the production of a smart digital health card of polycarbonate material, rather than paper because of the advantages of this material. The card also consists of many levels of secured features and a chip on which the medical data of the cardholder is stored.
The experimental study is divided into two parts:
The first part: describes the current health insurance card.

- Description of the current form of the health insurance card:

The card is a booklet which consists of a cover and an internal pages' group.

Card material: is divided into:

- cover material: consists of leathery material, (Arab Republic of Egypt / General Authority for Health Insurance / Health Card) are all printed on it with golden hot stamping foil.

- Internal pages: about 160 pages made of unsecured, 80 grams paper, the pages are printed by lithography printing method, the first page represents personal data and there is a watermark of General Authority's logo for Health Insurance, also the page contains a photo of the citizen installed on the page by a metal pin that is easy to take off and can be changed with another photo, the photo is secured by a simple stamp as shown below (see Fig. 10).

Card dimensions: 15.5 x 12 cm

(fig.10) current health card

It is clear that there are many problems resulting from using this conventional card:

1. The material of the cover and the internal pages are not sufficiently secured.
2. Also the internal papers are exposed to damage over time.
3. The life span is the shortest compared to other materials.
4. As well as the size of the card is a big size that is hard to carry and can be circulated.

Because of the vital role played by the health insurance system and its importance in the treatment of many sectors of society, it has become necessary to store all the data and information of the citizens on the systems in a database containing all patients' data like patients' history and allergy to certain medications.

The second part: is to present the proposed designs for a smart health insurance card which meets the conditions and specifications of security and safety.

Hence, the proposed health card designs will be different from the traditional card design in its material and size, as well as containing a chip carrying a lot of medical data of the owner of the card, that means converting the card from traditional to digital card.

Proposed design structure of the smart health card:

Dimensions of the card: 5.5 X 9 cm

Card material: Polycarbonate for laser engraving**.**

Polycarbonate is a promising plastic material in the field of smart card printing due to its outstanding operational and printing properties.

The most important operational features of polycarbonate are:

- Laser engraving to print personal data on the card.
- High mechanical resistance.
- Durability and high resistance against bending.
- Stable material at temperatures up to 240 ° C.
- The span life of the card is large compared to paper cards
- High transparency and recyclability.

The smart card will be divided into five layers of polycarbonate in different thickness, as follows:

First and fifth layer:

The thickness of these layers is about 100 microns, it is a transparent layer that protects the card from the handling, chemical and mechanical damages, and this layer can support the holographic effects.

Second and fourth layer:

The thickness of these layers is about 140 microns; these layers are containing three elements:

1- Printed image of the owner of the card, and a watermark (watermark for example, a medical image or the General Authority's logo for Health Insurance) through waterless offset printing.

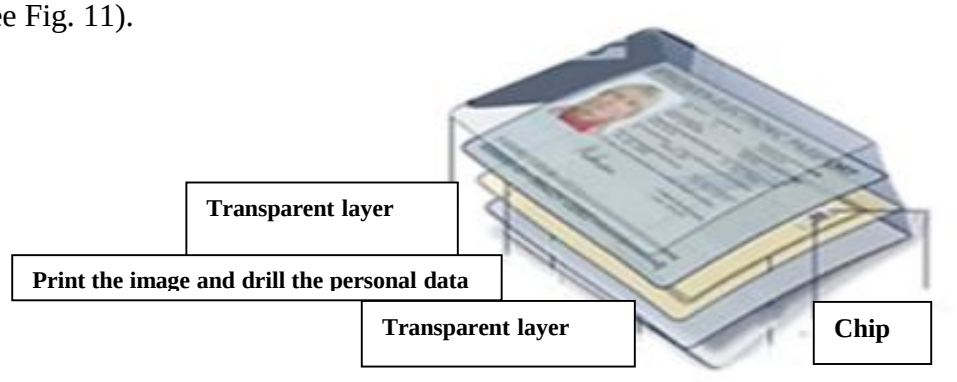
2- Guilloches flooring is designed through specialized programs for the production of Guilloches lines and is printed through waterless offset printing.

3- Laser engraving (burning) of the personal data of the card holder and a ghost image of the card holder.

4- **The third layer:**

Solid white layer of polycarbonate with a thickness of 300 microns where the contact chip (Variable data) is integrated into this layer and this chip carries all the medical information of the person such as dispensed medicines / allergy to certain drugs...etc.

This layer may also contain some of the person's biometrics; these are the unique measurements that are not identical with someone else, like a fingerprint and also Signature (see Fig. 11).



(fig.11) Structure of the body of the card body

During the manufacture of the card the five layers are combined under high temperature and pressure to form the card body.

Suggested health smart card designs:

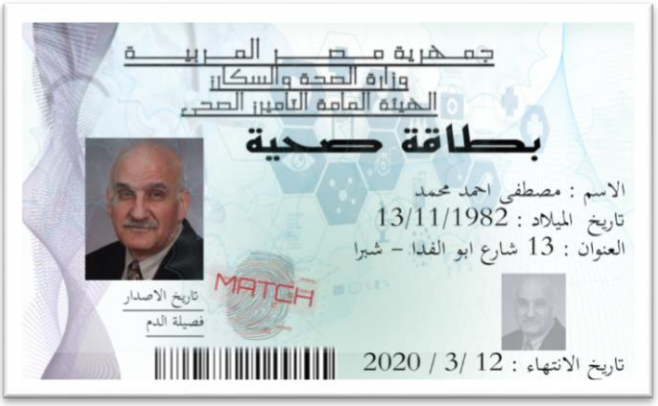
Design (1):

This design card is made of polycarbonate material and consists of five layers, contains a number of security features like watermark, Guilloches. The image of the card holder has a holographic effect. It is a technology called Personalized Embedded Hologram, which makes it difficult for the counterfeiter to reproduce this type of this technology. The card also contains ghost image and fingerprint, also chip where information and data of the person are loaded. (see Fig. 12).

Fig. 12): Proposed Smart Card Design (1)(

Designs (2, 3):

These design cards are made of polycarbonate material and consist of five layers, contain a number of security features like watermark, Guilloches, ghost image and fingerprint, also will be support with Chip where data of the citizen can be loaded (see Fig. 13& 14).



(Fig. 13): Proposed Smart Card Design (2)

(fig 14): Proposed Smart Card Design (3)

The results of the research:

1-The use of smart health cards allows the opportunity to combine more than one service in one smart card.

2-Using a smart health card in its health insurance system will help the doctors search for an individual's identity and patient history easily and quickly.

3- The use of a smart card provides the possibility to know the medical problems resulting from medication the patient may be allergic to.

4- The application of the intelligent health card provides a successful alternative for perishable paper cards in the size and material.

5- It is easy to support the smart cards with features and levels of security that prevent any person to imitate it.

6- The majority of health cards are in the form of a smart card all over the world.

The recommendations of the research:

1. The research recommends replacing paper health card with a smart secured card.
2. Renew the health insurance system in accordance with the physical components of smart cards.
3. Support the healthy smart card with smart chip that carries all the data about the citizen.
4. Apply Card Application Management Systems" (CAMS) to provide a secure operating environment by encrypting data and information.

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