

Smart Card Technology: The Cornerstone of the Application of Health Information Technology in Lombardy, Italy

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Abstract

The diffusion of smart cards within the health field is common in many countries and regions throughout the world. Italy's Regione Lombardia enjoys one of the more successful applications of health information technology in Europe, and the current state of its accomplishments is examined in this article. Other European countries and regions are also using health smart card programs, and some are moving beyond using the card simply for health insurance. Programs in Andalucía, Austria, Belgium, Finland, France, Germany and Slovenia are reviewed here, too.

Introduction

A smart card, chip card, or integrated circuit card, is defined as any pocket-sized card with embedded integrated circuits that can process information. Smart cards are usually plastic (e.g., a traditional credit or debit card) and contain a built-in integrated circuit chip used for identification and authentication purposes. When inserted into a reader, the smart card transfers data to and from a central computer. Smart cards are generally more secure than a magnetic stripe card and can be programmed to self-destruct if the wrong password is entered too many times. The card may embed a hologram to avoid counterfeiting.

The chip card was supposedly invented by German rocket scientists in 1968, and the patent was finally approved in 1982. The first mass use of the cards was for payment in French pay phones, starting in 1983. Smart card-based electronic purse systems (in which value is stored on the card chip, not in an externally recorded account, so that machines accepting the card need no network connectivity) were tried throughout much of Europe from the mid-1990s onward.

Smart card technology has been introduced in personal identification and entitlement schemes at regional, national and international levels around the world. Citizen cards, drivers' licenses and health card schemes are becoming more prevalent, and contactless smart cards are being integrated into International Civil Aviation Organization biometric passports to enhance security for international travel (Marceglia and Pincioli 2005).

Types of Smart Cards

Smart cards contain different types of embedded chip technologies such as contact smart chip, contactless smart chip and proximity chip. A contact smart card has a single embedded integrated circuit chip that contains just memory or memory plus a microprocessor. Contactless smart cards use radio frequencies to provide a wireless connection to the reader. The

transmission range is only a couple of inches but allows the card to be quickly passed by a reader in applications such as secured entrances. Proximity cards are similar to contactless smart cards, except that they are read-only.

Commonly used terms such as “Bancomat,” “credit card,” “store entry pass,” “supermarket card” and others make up a family of computerized cards that function as an access key. Access to cash in an account, to credit, to store property, to a supermarket’s end-of-year discounts – all these functions revolve around access, and as such they require little data. Each of the aforementioned cards typically has a magnetic read-only strip on the reverse side. While this strip contains limited memory capacity, it is sufficient for the card’s intended purpose. At present, the memory limit is fewer than 300 characters. The cardholder’s photograph is occasionally found on the computerized card (Marceglia and Pinciroli 2005).

A different technology is the prepaid magnetic-strip computerized card. This type includes many phone cards that are inserted into public telephones, as well as prepaid credit cards. The card is overwritten the moment it is used. In the overwriting process, usually executed gradually, the original amount shown as available on the card is progressively reduced.

Greatly different in appearance are microprocessor-equipped computerized cards. In general, the microprocessor can be seen with the naked eye. Functions carried out by some of these cards, such as the French phone card, do not surpass those that prepaid information cards can typically perform. Nevertheless, the range of services that a microprocessor card can provide is programmed to different areas of activity made accessible through successive validation steps and filters.

European Health Insurance Cards

Asia (especially Taiwan) and Europe have long histories of health insurance card schemes. In many countries, a new electronic health insurance card (which may include a multipurpose lifelong identification number) has replaced the simple plastic card each person receives from his or her insurance company; most of these cards have a microprocessor chip that permits authentication (an electronic identity check), encryption and an electronic digital signature. Examples from several European countries using such cards within their healthcare systems follow. Some are moving beyond using the card simply for health insurance purposes.

Andalucía (Spain)

Almost every region in Spain uses smart cards. Andalucía has had smart health cards for its 8 million citizens since 1996. Providers access patient data in DIRAYA, a citizen-centred health solution implemented in the health and social care service of Andalucía. It includes an identification system based on smart card technology, a database and a single electronic

healthcare record. The health card is the key that allows healthcare providers to access a single electronic clinical record for each citizen, with data from any of the 1,500 primary health centres or 37 hospital emergency departments and outpatient clinics throughout the region (Protti et al. 2009).

Austria

In February 2001, the association of Austrian social security institutions was entrusted with introducing a health insurance smart card (e-Card) as a basis for an electronic administration system (ELSY). ELSY is a secure network that supports the administration processes between the insured, employers and contractual partners (doctors, hospitals, etc.), as well as social security institutions. It is designed so that laws can be executed without paper documents.

By the end of 2005, Austrian social insurance institutions had introduced an e-Card and a new electronic process that eliminated the need to issue and process more than 40 million healthcare vouchers annually. All 9 million insured persons in Austria and nearly 12,000 physicians have an e-Card; the professionals’ card is tied to the location of their office. Over 300,000 patient contacts are processed daily via the e-Card system. The e-Card serves as the patient’s proof of claim with the physician (or dentist) and replaces all forms of the traditional health insurance vouchers of all social security institutions. Thus, the cardholder can access medical treatment without administrative barriers and paper documents.

On the reverse side of the Austrian e-Card is the European Health Insurance Card (EHIC). The EHIC replaces the international health insurance voucher (form E111) for claiming medical treatment during temporary visits (e.g., holidays) in member states of the European Union, the European Economic Area and Switzerland. Austria was one the first European countries to integrate the two identity cards.

In 2007, an extension of the e-Card system to an electronic health record (elektronische Gesundheitsakte, or ELGA) was introduced as part of a 2007–2012 government plan. ELGA’s goal is to make health-related patient information centrally available for the attending physician, patients and institutions in the health system. Core applications of the first implementation phase of ELGA, scheduled to begin in 2012, consist of e-Medications and electronic sharing of diagnostic imaging, laboratory results and hospital discharge summaries.

Belgium

National ID cards have been in use in Belgium since 1919. Belgium was one of the first European countries to issue an electronic identity (e-ID) card, in 2000, to all citizens aged 12 years or older. The visual design is similar to the previous identity card’s. It contains the holder’s name (family name, up to two given names, and the initial of a third name), title,

nationality, place and date of birth, gender and photo. It also includes the holder's national number and hand-written signature, the card's validity dates (the card is valid for five years) and number, and the place of the card's delivery. As a biometric feature, Belgium decided to use a photo (Figure 1). The chip on the card can perform digital signatures and key generation.

Figure 1. The front of the Belgian identity card



With close to 8 million cards in use at the end of 2008, Belgium's is one of the largest e-ID schemes in Europe. The Belgian e-ID is the electronic key to more than 600 e-Applications on the Internet. Numerous public services are now available online, and procedures that would have taken hours (e.g., requesting a birth certificate) now take a matter of seconds (France et al. 2007).

Finland

In Finland, the identification card is one of two official identity documents (the other is the passport), and citizens are expected to obtain one. The ID card is electronic and enables logging in to certain government services on the Internet. The national population register centre creates an electronic identity for Finnish citizens when providing them with a personal identity code. The electronic identity is a dataset consisting of a series of numbers and a check character. It helps identify Finnish citizens and, in accordance with the Municipality of Residence Act, foreign citizens permanently residing in Finland who are entered in the population information system.

Since 2004, Finnish citizens have been able to include their health insurance data in their electronic ID cards. At the recommendation of the data protection ombudsman, it was decided that each individual could opt for a single card. This enables the cardholder to also use the card as a health insurance card (KELA card). These identity cards are valid for five years. As of

December 2009, citizen certificates had been issued to a total of 286,000 people, and 123,000 people had integrated their health insurance information into their ID cards.

France

France has always been at the cutting edge of smart card technology, first deploying it in the healthcare industry in the early 1990s to simplify the reimbursement system. The data entry system for SESAM-Vitale electronic health insurance replaced the standard paper individual health insurance cards with a smart card, the Carte Vitale, containing administrative data. One card was issued to every family in the system in order to simplify the administration process, reduce paperwork costs and provide a faster, more efficient and secure way of submitting claims for reimbursement (GIE SESAM-Vitale 2006).

The SESAM-Vitale system uses two cards – the patient data card and a health professional card – to electronically sign claim forms and send them directly to the patient's health insurance provider. More than two decades since it was launched, the SESAM-Vitale scheme has grown to include some 53 million patient cards, 600,000 health professional cards, 200,000 card readers, 20,000 terminals for updating cards, 230 health software applications and 25 servers handling the transaction flow across a dedicated telecom network.

The second generation, Carte Vitale 2, was deployed in 2006, with cards issued to every person over 16 years of age eligible for French social security coverage. It contains a chip with 32 kilobytes of memory and carries a photograph of the owner; the data in each card is encrypted for enhanced security. The card is a critical component of the personal health file (DMP – dossier médical personnalisé), which contains information (e.g., family doctor, organ donation direction) that is being integrated into the existing infrastructure. In response to the needs of healthcare institutions, a new card – CPS 3 – is being introduced in mid-2010. It will incorporate a number of changes visible to the user, including contactless reading to make the card more user-friendly in specific situations within health institutions (French Entrée 2007).

Germany

In 2003, the German parliament passed healthcare modernization legislation that required the introduction of patient data and health professional cards. The law requires that the electronic patient data card contain a photo of the insured person printed on the front and the holder's basic data (printed on the surface and stored in more detail on the chip), and that it be used in mandatory applications such as electronic prescriptions. Card issuers may add optional applications, such as emergency data and an electronic signature.

In 2006, the new electronic health card – the elektronische Gesundheitskarte (eGK) – and the electronic health profes-

sional card were introduced into the German health system. The electronic health card was to become the electronic key to cross-institutional interlinking of more than 80 million patients with about 123,000 general practitioners (GPs), 2,200 hospitals, 65,000 dentists, 21,000 pharmacies and over 250 health insurance companies.

In January 2009, the key clinical components of the national e-Health smart card program were delayed due to problems encountered in the first seven pilot sites. Electronic prescriptions, electronic emergency data sets and electronic medication safety applications were expected to be suspended. The first problem involved difficulties with PINs. For creating the emergency data set, or emergency record, German legislation requires the patient to enter a PIN. But the early studies from the test regions found that up to 70% of individuals had forgotten theirs. The second reason for the failure was the need for digital signatures, upon which services such as electronic prescriptions depend. Doctors argued that the signature process takes far too long.

In January 2010, Germany shelved the introduction of the country's e-Health card system, which had so far cost 1.8 billion euros (2.3 billion US dollars). The new German government, a coalition of the Christian Democrat Union and the liberal Free Democratic Party, had decided to review the e-Health card plans, which were the work of the former Social Democratic Party health minister Ulla Schmidt, because of criticisms from doctors and experts about the safety and security of data and the feasibility of the technology. The cards will continue to be issued in specified trial areas but will contain only the patient's basic personal data, insurance status, a photograph and a small set of health data in case of emergency – if the patient has agreed to this information being put on the card. The scheme was supposed to make 700 million handwritten prescriptions redundant, thus saving much of the cost of the system's introduction. Health insurance companies were opposed to shelving the scheme because they want a new card as a substitute for their present membership cards, which do not have a photograph and are misused (Smart Card Alliance 2010).

Slovenia

In May 2009, Slovenia's health insurance institute announced that it would roll out a new electronic health insurance card system across the country. Initially being used for insurance data, the e-Health card is the basis for adding future e-Health services, including e-Prescriptions and electronic health records. The new system will enable healthcare providers to check a patient's health insurance status and allows online claims processing. Previously, patient insurance data was stored in the insurance card rather than on a remote server. Patients had to update their cards on self-service terminals every few months. The national rollout follows a pilot, completed in March 2009, at the Dr. Franc Derganc General Hospital Nova Gorica (E-health Europe 2009).

The system will be fully operational by the end of 2010 and will be used by more than 30,000 health professionals and two million patients. Although a number of countries across the globe have electronic health insurance systems, Slovenia is one of the first to integrate both public and private insurance organizations. In addition to the health insurance data recorded on the card of each resident, 82% of the population already have data on dispensed medications recorded on the cards, while 13% also have data on medical devices they have received. Over 1,000 persons also have their decisions on post-mortem donation of organs and tissues for transplants recorded (E-health Europe 2009).

The Lombardy Health Smart Card Project Background

The region of Lombardy, in the north of Italy, is one of the country's 20 administrative regions. With around 9.5 million inhabitants, it represents about 16% of the Italian population. The regional government (Regione Lombardia) is responsible for healthcare delivery. In 2000, against the background of growing demand and limited resources, the Lombardy Region began introduction of a local hospital information system (HIS) in each hospital and the implementation of a regional network. Lombardy adopted a "non-invasive" approach, respecting the independence of the region's hospitals and integrating already existing local systems rather than replacing them. To create new services such as an electronic health record (EHR) and e-Prescribing at the regional level for both citizens and healthcare professionals, healthcare provider organizations such as hospitals needed a local information system. Lombardy supported the integration of almost all existing systems from a technology perspective, providing an enabler for information sharing and exchange (EHR Impact 2010).

In the wake of the European Netlink project, Lombardy launched its regional service card and healthcare and social service information system (Carta Regionale dei Servizi della Lombardia – Sistema Informativo Socio Sanitario, CRS-SISS). The project's goals were to introduce greater efficacy and efficiency in the distribution of healthcare services through:

- Improvement of services to citizens, by reducing the "distance" between citizens and healthcare organizations;
- Planning, management and redistribution of healthcare resources;
- Reduction of information latency within the system;
- Establishment of a standard of access to telecommunications services, with the necessary prerequisites of security, interoperability and compatibility; and
- Completion of connections that would include not only healthcare services, but also other public services in the region (e.g., automobile taxes, garbage collection and removal, heating system maintenance schedule).

The heart of the project consisted of recording prescriptions in real time, thus making them immediately available, as well as:

- A secure method for identifying the citizen; this would adhere to standards and be interoperable and directly accessible by computer systems;
- The opportunity to request healthcare services from the family physician or pharmacists;
- The capability to gain access to the wait times of all of Lombardy's healthcare organizations (including accredited private ones); and
- The creation of a database containing all requests for specialist reports and discharge letters; the database would be patient-centred and available for consultation by all physicians so authorized by the patient (Marceglia and Pinciroli 2005).

The pilot of the new SISS network was conducted from 2000 to 2002, before the health information network's expansion to all districts in the region was initiated in 2002. By 2005 the entire region was connected, comprising all 34 public hospitals, 7,700 GPs, all 2,600 pharmacies and around 9.5 million citizens. Currently, 93% of all GPs and pediatricians in Lombardy, all public hospitals and all pharmacies are connected to SISS. As of January 2010, about 70% of all 350 private healthcare providers were also connected with SISS, and 50 of them have integrated their information system with the regional health network.

SISS is divided into three levels:

- The first consists of two large repositories of information, the Domini Centrali Famiglia (family central domains) and Sanita (healthcare) – healthcare data pertaining to the citizens of Lombardy.
- The second consists of an extranet that allows the information in the two principal repositories to be exchanged within the region.
- The third provides the ability to access the data from the two repositories.

SISS is operated by Lombardia Informatica (created in 1981 and wholly owned by the Region of Lombardy), which has contractual commitments with the private sector providers Telecom Italia, Finsiel and Lutech to furnish the human and financial resources required for the system. With 700 staff, Lombardia Informatica is primarily involved in the healthcare sector and is responsible for development and design of the region's new IT systems and the maintenance of existing ones.

The CRS card

A vital component of SISS is the CRS (Carta Regionale dei Servizi), which records multipurpose information on a microchip (Figure 2). The new card, introduced in 2006, replaced the

paper or plastic Codice Fiscale card (fiscal code – a tax number similar to a social insurance number), a separate paper healthcare card (in existence since 1986) and the exemptions card. The CRS is based on Netlink technology, the reference platform for the National Health Care Card according to the dictates of the Group of Eight (Official Journal of the European Union 2003) and thus is compatible with the European Health Care Card, form E111.

Figure 2. The front of Lombardy's CRS (Carta Regionale dei Servizi) card



The CRS card contains data on its surface, on the microchip, within the magnetic strip and in the barcode (the latter two are on the back of the card). Visible on the surface are first name, last name, birth and place of birth, fiscal code, health insurance code and card expiration date. Data stored on the microchip include those on the surface, as well as home address, health insurance data, local healthcare authority (ASL – Azienda Sanitaria Locale), name of family physician and exemptions-related data. Also on the chip are an electronic certificate for the secure access to the system and the application for the digital signature. The magnetic strip contains the first and last name and fiscal code, while only the fiscal code is on the bar code; the magnetic strip is needed because the card also acts as the Codice Fiscale card.

By submitting the CRS card to their GP or healthcare organization, citizens are uniquely identified and a link is created to their electronic medical record, stored in the facility at which they present themselves. In addition to serving as a health card, the card is used to access public administration services at local, regional and national levels (e.g., for income tax declaration and payment) (Regione Lombardia 2009).

Italians must register with a GP within their ASL. They may choose any GP in the ASL but may not go outside it. Except for emergency care, a referral from a GP is required for diagnostic services, hospitalization and treatment by a specialist. Primary care physicians in Italy are reimbursed on a capitated basis (i.e.,

according to the number of patients served over a given time period rather than the services actually provided).

The SISS Card

The SISS card is the healthcare professional's access key and contains his or her authorization data on a microchip. By inserting the card into a workstation, the user is uniquely identified and is able to access SISS services that correspond to his or her professional duties. Users who have been trained in electronically signing documents are able to affix their own electronic, legally valid signature directly onto the document produced by SISS and transmit the document to an authorized party. All primary care physicians and nurses use the card in all primary care settings to access data, review results, electronically document notes and generates orders.

All pharmacists in community pharmacies in the region also use their cards to access medication prescriptions from physicians and to dispense medications, all the while updating the patient's medication profile. All authorized physicians in the region can access the profile. A card is also used in acute care hospital settings, including emergency departments and ambulatory clinics.

With the patient's CRS card and his or her SISS card, the primary care physician is able to:

- Record and send prescriptions to the pharmacy (over a private, secure network in which data are encrypted and decoded only by authorized parties);
- Record and send requests for specialist care or in-patient and outpatient examinations;
- Make appointments for the patient with a specialist and arrange for examinations directly from his or her office; and
- Access, in his or her office, the results of examinations and hospital admissions ordered for the patient. The doctor receives e-mail notification as soon as the data are made available by the healthcare organizations responsible for performing the service.

e-Referrals

When GPs refer their patients to specialists in practices or hospitals, the law requires that they use a paper form, even when they refer their patients electronically. This requirement also holds for drug prescriptions. The paper form, which is filled in electronically, contains a bar code that identifies the referral details. GPs use the Lombardy health information network to make referrals, access their patients' lab or examination results from hospitals or specialists, and communicate with other physicians. Orders are sent to the central data repository of SISS when the patient receives the corresponding paper form. Information on the paper form is then entered into the local hospital's information system (HIS) data repository or into the

specialist's practice local information system. Entry is facilitated by reading the bar codes on the paper referral form. One bar code contains the patient's demographic information, the other the details of the medical order. Potential uncertainties resulting from interoperability challenges must be addressed manually.

Lab and examination results generated in the hospital or the specialist's practice are also entered into the local HIS. When the physician produces a report of the test results, the local HIS creates a PDF document. These documents are signed digitally, an event that triggers a notification in SISS and to the referring physician that the report is available. Initially, hospital physicians had to initiate this process for every report individually. Now, they can sign several at once. Physicians do not have to make all reports available through SISS, nor do they have to include all information in the reports. Before generating the PDF document, a physician can decide to limit the information available. Reasons for such decisions include uncertainties and the need for further clarification; sensitivity of information, especially regarding particular diseases such as HIV/AIDS; or the need to provide information personally to the patient, for example, in the case of a cancer diagnosis.

After notification that the report is available has been sent to SISS, an e-mail containing the link to the document is sent to the referring GP. To view the information, GPs follow the link and identify themselves with their card and PIN. Following the same route, GPs receive messages when their patients are hospitalized or discharged. They can then access the documents stored in the patient's EHR.

Using the CRS, patients can also view their documents. They can ask for a PIN at the post office and use a card reader to view their results, without visiting their GP or the hospital. The system also allows patients to not impart their health information to certain healthcare professionals. If they do not want to share their information with their GP, the latter will need the patient's card in order to view the information in SISS. Each data item (signed report) is marked as "free for access by citizen" if not explicitly marked otherwise (EHR Impact 2010).

e-Prescribing

In contrast to referrals, prescriptions are saved centrally, although the prescription is issued on paper, as well. (Legislative changes are required to allow full implementation of e-Prescribing replacing the paper-based system.) Nevertheless, pharmacists can also access prescriptions electronically. Pharmacists can view medication prescribed within the previous six months. Long-term prescriptions with repeat dispensing are limited to two months' duration, whereupon patients must return to their GP for a new prescription. Dispensed drugs are also registered and made available via SISS, making the drug management process a step further ahead than the prescription itself. Once a month, pharmacies send details on dispensed drugs to Regione Lombardia for

reimbursement and statistical purposes. Prescription details are included, so that any specific prescription can be linked to a dispensing procedure. Since the pharmacies' local information system interfaces with SISS, the electronic document is generated automatically and transmitted directly. Thus, patients' complete medication history is present in SISS, but since the medication data is uploaded in the EHR monthly, it is not available in SISS in real-time but deferred by up to one month.

e-Booking

Currently, hospital ambulatory services can be booked electronically via the region's call centre, at pharmacies, at GP offices, and via the Internet by citizens themselves. e-Booking also triggers a reminder of an appointment via an SMS text message. First encounters with GPs or pediatricians cannot be booked electronically yet. e-Booking requires referrals; to make an appointment electronically, patients use either their citizen card, their fiscal number (which is on the citizen card), their identification number or the referral code. All this information is also visible on the paper referral document. Once patients have entered referral information, they can choose a specialist, a particular hospital or their LHA, and the particular day and time. SISS searches for and displays available time slots according to the patient's request and also provides information on the maximum wait times. From this pool of appointments, patients can pick the date, time and location that fit them best. It is also possible to cancel a scheduled consultation: a new appointment automatically cancels previous appointments for the same referral.

Disease-Centric Pathology Networks

A recent development is the establishment of pathology networks with the aim of utilizing the opportunities provided by SISS for continuous and ubiquitous care for those who need it. Three pathology networks are currently active: oncology, epilepsy and rare pathologies. Another five, covering cardiovascular and stroke-related diseases, dialysis, hearing and the phenomenon of infant death, are being implemented. These disease-centric networks share data and documents more extensively and contribute this information to the patient's EHR. All health documents are stored in hospitals and consist of both structured documents and text files. A hospital is appointed to define the content standards and structures of the documents for the respective network.

Data Protection and Patient Consent

Since the SISS system is based on information sharing among professionals, special attention is given to citizens' privacy. To this end, the steps outlined above are taken only when the citizen has consented to the handling of his or her data by parties normally authorized to do so. In the event that the citizen has

not signed and submitted an information consent form for the handling of sensitive data (the form is submitted together with the CRS), the system will not initiate any procedural steps. These data include, for example, the sharing of reports, medical cases and discharge papers. Furthermore, the system uses the most advanced technology available (e.g., digital signature, user verification based on a Public Key Infrastructure (PKI) and data encoding) to guarantee the security of citizen's data.

The SISS network requires both the citizen and the health professional cards for access to personal patient data. The citizen card (CRS) is automatically sent to Lombardian citizens by the Regione Lombardia. In order to activate the card and allow medical and health administrative data to be stored in SISS, citizens must give their consent. This can be done at pharmacies, hospitals and other healthcare institutions. After this one-time consent has been given, the LHA activates the card. As soon as this procedure is completed, the patient's regional EHR (simply a series of pointers) is created, and the data can then be accessed by healthcare professionals and (to a certain extent) by citizens. Citizens have the power to give or block access by some or all healthcare professionals; this can be done for all, or only a part of the information that is available through the SISS.

Citizens use the CRS as a way of providing explicit consent for healthcare professionals and healthcare administrators to access personal health information. The health professional card (SISS) allows authentication according to the professional's profile, as accredited by the regional health authorities. The health professional card, together with the health professional's PIN, is the key to digital signatures on documents. This functionality is critical for exchanging medical information, as it enables professionals to trust the information they access. All documents available in SISS must be digitally signed before they are made available to other healthcare providers.

Whenever healthcare professionals want to enter the SISS network, they need their professional cards and PIN. Information upload does not require the patient's card but is authorized by a digital signature. Each information upload procedure requires an explicit entry of the professional's PIN, while the card is in the reader. GPs can access their patients' EHR data at any time, as patients provide their formal consent upon their first registration. As in Andalucía in Spain, in hospitals, healthcare professionals need the patient's card whenever they wish to view the documents available in other healthcare organization information systems. Only in the case of an emergency can any professional with a health professional card access the record. A message will then be sent to the patient and his or her GP to inform them about this incident.

The Current Status of CRS/SISS Project

As reported on the online portal of the Region of Lombardy (<http://www.crs.lombardia.it/>), as of October 31, 2009,

almost 9.5 million CRS cards were in active use – representing over 99% of the population – with 42% having a PIN/PUK (personal unblocking key) attached to the card. Over 300,000 card readers were installed throughout the Region, not counting those in hospitals or at other healthcare facilities.

Online services available to citizens allow them to:

- Access personal data (*SISS Dati Anagrafici*);
- Access their personal medical record (*SISS Fascicolo Sanitario Elettronico [FSE]*);
- Choose a general practitioner (*SISS Scelta Medico MMG*);
- Provide informed consent regarding personal data management (*SISS Consenso online*); and
- Book specialist examinations (*SISS Prenotazioni online*).

Analysis of data related to citizens who access the online services pointed out that there are about 4,000 new users every month. In addition, as more and more hospitals are implementing online booking systems, the number of examinations booked online is steadily increasing (Monthly Report on CRS Project 2010).

Conclusion

The diffusion of smart cards within the health field is quite common in many countries and regions. The Lombardy region, where the CRS–SISS project was launched more than ten years ago, is one of them. There, the citizen's smart card serves not only as a key to an interconnected health care system; it also allows citizens to access several services from their homes. The connected healthcare providers have access to a variety of reports, thus complementing the information in their local electronic patient record systems with information from other healthcare organizations. Reports available through the SISS system include lab tests, examination reports, referrals, vaccination records, therapeutic plans, discharge letters and e-Prescriptions. A regional data warehouse collects the information contained in the local information systems and enables data analysis for institutional-administrative purposes, such as healthcare planning, resource planning and epidemiological analysis.

The creation of a local and regional health information technology (HIT) infrastructure based on a smart card is considered the cornerstone of Lombardy's e-Health strategy. HIT is considered essential to increasing health workers' ability to share relevant individual data and to give them the easiest possible access to up-to-date medical knowledge from accredited sources. Although the number of healthcare facilities connected and the number of healthcare professionals and citizens using the network is very high, and clinical information can be shared, the information is limited to documents, not structured text. Nonetheless, accomplishments to date suggest that Italy's Regione Lombardia enjoys one of the more successful

applications of health information technology in Europe. **EH**

References

- EHR Impact. January 2010. "The Socio-economic Impact of the Health Information Platform Sistema SISS in the Region of Lombardy, Italy." Retrieved June 1, 2010. <http://www.ehr-impact.eu/downloads/documents/EHRI_case_SISS_final.pdf>.
- E-health Europe. 20 May 2009. "Slovenia Rolls Out E-health Card." Retrieved September 15, 2010. <http://www.ehealthurope.net/news/4860/slovenia_rolls_out_e-health_card>.
- France, F.H., M. Bangels and E. De Clercq. 2007. "Purposes of Health Identification Cards and Role of a Secure Access Platform (Be-Health) in Belgium." *International Journal of Medical Informatics* 76(2–3): 84–8.
- French Entrée. Languedoc Roussillon. 2007. "New Health Card Introduced across France." Retrieved May 10, 2010. <<http://www.frenchentree.com/languedoc-family/DisplayArticle.asp?ID=24365>>.
- GIE SESAM-Vitale. 2006. The SESAM-Vitale program. Accessed May 10, 2010. <http://www.sesam-vitale.fr/programme/programme_eng.asp>.
- Marceglia, S. and F. Pinciroli. 2005. "Carte informatiche sanitarie." In F. Pinciroli and M. Masseroli, eds., *Elementi di informatica Biomedica* pp. 23–52. Milan: Polipress Editore.
- Monthly Report on CRS Project. 2010. *Sviluppo CRS – Report Mensile (Aggiornato a Novembre 2009)*. Retrieved May 10, 2010. <<http://www.crs.lombardia.it/ds/Satellite?childpagename=CRS%2FCRSHomeLayout&c=Page&pagename=CRSWrapper&cid=1213346611964>>.
- Official Journal of the European Union. 2003. L.276, 27.10.2003 – Decisions 189, 190, 191. Retrieved May 10, 2010. <<http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2003:276:SOM:EN:HTML>>.
- Protti, D., I. Johansen and F. Perez-Torres. 2009. "Comparing the Application of Health Information Technology in Primary Care in Denmark and Andalucía, Spain." *International Journal of Medical Informatics* 78(4): 270–83.
- Regione Lombardia. 2009. "Carta Regionale dei Servizi. Servizi On-line. Servizi degli Enti Centrali." Retrieved June 7, 2010. <<http://www.crs.lombardia.it/ds/Satellite?childpagename=CRS%2FCRSHomeLayout&c=Page&pagename=CRSWrapper&cid=1213346611964>>.
- Smart Card Alliance. 2010. "German Health Card." Retrieved May 10, 2010. <http://www.smartcardalliance.org/resources/pdf/German_Health_Card.pdf>.
- The Electronic Health Card. 2006, October. Federal Ministry of Health. Berlin. Retrieved May 10, 2010. <<http://www.die-gesundheitskarte.de>>.

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