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Optimization of information systems to strengthen health systems stewardship and health-care performance

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1. Summary and recommendations

1.1. Summary

Digitalization in health and social security ranks high on international, national and regional social policy agendas. Digitalization improves the quality and efficiency of healthcare, it supports faster and ubiquitous access and has inspired the onset of many new services in support of wellness, health and social security. An increasing preponderance of digital readings, images and reports, i.e. paperless health and healthcare documentation, enables significant innovations in healthcare.

- For the healthcare provider, e-health supports more precise diagnoses, better treatment and most notably its follow-up, easy and meaningful quality monitoring, support for patients at home and on the move, etc. Provider collaboration is enhanced, e.g. in the form of remote treatment, second opinions and integrated care.

- Smart health cards, some utilizing biometrics, support easy access of beneficiaries to care, reduce healthcare fraud, improve the security and privacy of patient information, provide secure access of authorized health professionals to, for example, emergency medical information and enable compliance with government and/or health insurers initiatives and mandates.

- In the many emerging digital health environments, citizens and patients gain easier access to their own health data, enabling in turn the co-creation of health and healthcare. Patients become informed partners in decision making. Not least, this helps to allocate healthcare resources where they are most needed and bring about optimal benefit.

- The pervasive spread of mobile platforms adds a new and powerful stream of digitalization in the health and wellness domains. Health insurance providers have started to extract additional insight into the preventive behaviour of insured persons and to offer individual

tariffs that honour additional fitness activities of the insurees in the form of financial incentives.

- Electronic Health Records (EHR) – a powerful e-health tool on their own – start most notably to become accessible on mobile platforms: This enables flexible "healthcare on the move" for health professionals, e.g. viewing patient data on a tablet and updating it by using the inbuilt dictation facility. Mobile devices allow, moreover, easy access to EHR by citizens and patients – safeguarding privacy with security tokens (mTANs) or the GSM smart card.

Consequently, an increasing number of nations around the globe are building on e-health to deliver public health and health services in a more strategic and integrated manner. This report integrates International Social Security Association (ISSA) member organizations' country data collected via a questionnaire and complementary desk research to develop a consistent overview on the state of the art of digitalization and to render the following perspective: Smart cards support security and privacy by supporting authentication/authorization *to*, as well as the storage *of* health data. For the role of smart cards in practice, this means that Health Information Systems use them either as a security token to enable access to a patient's health data stored on a network, directly as storage for medical data, or for both.

- A first generation of healthcare smart cards was introduced in European health systems, such as France, Germany and Belgium, purely for administrative purposes. Second generation cards – issued also in Asian countries – are also used for clinical purposes.

- Many eHealth strategies – documented in country questionnaires – limit the use of smart cards to manage the access of health professionals and/or patients to online storage of health data.

- Newer strategies avoid the need for smart card readers by involving Mobile platforms for authentication – some using the security features of sophisticated GSM smart cards. Given the high numbers, any mobile device based system benefits from massive economy of scale effects. So far, these systems are often established as a second, alternative solution by national health administrations.

1.2. Recommendations

Global and national strategies should be driven by a service perspective: A holistic view of the organizational processes, structures, roles, standards and legislation is needed, as well as consideration of human resources, education, professional cultures and reimbursement.

- Demonstrate benefits for healthcare organisations/providers (GPs, specialists, hospitals, and of course insurers) as well as for patients.

- Leveraging eHealth as a national strategic asset demands a coordinated approach to planning, implementation and evaluation.

- Establish (health-) cards (just) as one element in a broader identification and authorisation strategy supporting access to health services.

- The healthcare identity management infrastructures must have a way to uniquely and securely authenticate each person across the healthcare infrastructure, whether that interaction is in person or over the Internet.

1.2.1. Reconsider the privacy and security domains in the era of cyberattacks

- New era of hacker attacks on healthcare institutions have materialized. Healthcare represents a mission critical infrastructure of modern societies. Ransom ware attacks have recently blocked complete hospitals or crucial parts of them (operation theatres) from functioning.

- If the strategy does not yet involve cards, it may be time to reconsider means of strong authentication given the current threats of cyberattacks.

1.2.2. Managing priorities and building services involving health cards by a stepwise approach

A recommended starting point are basic card services that do not require storage on the card. These services are identification, authentication and authorization/moderation of access to health and social care services.

A next step is defined by health-related eServices that store limited amounts of data on the card. Examples of card-bard based services of this category are:

- emergency data;

- immunisation records;

- healthcare related financial services like co-payments.

Beyond cards: Message based services (i.e. no data repositories needed/implied):

- electronic prescriptions, dispensation information and medication history;

- electronic referrals;

- reports (use as much coding as possible);

- simple report, e.g. lab reports:

  - medium: imaging reports (ultrasound, X-ray, MRI etc.);

  - complex: specialist reports, discharge letters.

Beyond cards: Repository and index based services:

- institution-spanning electronic health records;

- assess to digital health data via web portals and web services;

- assess to digital health data via mobile platforms: these offer the benefit to easily support identification and authorisation for online services. As opposed to classical smart cards, smart phones and tablets have card access already inbuild – so no extra hardware is needed on the part of the user.

1.2.3. Opportunities of mobile platforms for health insurers – public health systems

Mobile platforms are also a suitable container for a new family of services to be offered by health insurance:

- health information prepared for lay users;
- provider directories – to be linked to booking services in the future;
- wellness Apps;
- Apps in support of the management of chronic diseases.

1.2.4. Opportunities of mobile platforms for health care providers – health systems

Mobile platforms may be used as containers to send personal health data to the patient (lab results, reports, full patient summary cf. Blue Button initiative in the United States).

- enable patients to receive reports;
- replace existing personalised reports and information on paper (example: up-to-date, full medication plan of patient);
- platform for collecting and forwarding telemonitoring data as well as other patient generated data (e.g. daily measurements of blood pressure, blood glucose, pulsoxymetry);
- universal platform for EHR access.

1.2.5. Generic recommendations for the clinical and technical implementation of digital health

Implement proven and established international standards and coding systems from the beginning of any development and deployment. Check for available solutions by the industry and other implementers to avoid re-inventing the wheel.

- There seems to be international consensus on the HL7 family of standards (incl. FHIR), DICOM, LOINC etc.
- IHE profiles provide useful guidance how to orchestrate the standards towards an operational communication infrastructure.
- Adopt high level agreements on International Patient Summary or the Guidelines on Cross-border data sharing agreed by the member states in the eHealth Network.
- Coding should be implemented with ICD10, SNOMED-CT may come in as nomenclature.

2. Introduction and scope

Many efforts are under way today to address the challenge of rising health-care costs faced by health insurance systems. The pertinent question for health insurance systems is how to sustain health systems to meet population needs and deliver excellent services.

In a recent publication, the Organisation for Economic Co-operation and Development (OECD) states that

> "all countries can improve their health information systems and make better use of data for quality, safety and performance gains and to advance medical treatments and practices. Many countries are at the beginning of a complex journey to encourage the development and safe use of health data".[1]

Therefore, this report examines this challenge, presenting good practices and experiences on the optimization of in-formation systems from the perspective of health providers and health insurance systems.

Balancing the scope: Recent decades have seen a pervasive digitalization in health-care provision. Small but growing numbers of health-care providers even operate fully paperless. In addition, the last years can be characterized by rapidly evolving citizen-held mobile platforms (smartphones, tablets), including the ubiquitous use of wearables: fitness trackers are linked to wellness Apps; smartphones collect monitoring data from Bluetooth-enabled wearables (blood pressure, glucose, weight, oxygen saturation) and send them on to tele-health support centres. Likewise, mobile platforms are used as interfaces for Electronic Health Records (EHR) including diagnostic images. As a consequence, mobile platforms have grown into indispensable building blocks of health-IT infrastructures.

The above trends have led to increasing diversity in national e-health strategies regarding the use of smart cards as building blocks of e-health infrastructures: some countries rely on card-based certificates (patients, health professionals, health providers = institutional certificates) for the authentication and authorization of all parties to health-care communications; some deploy smart cards either for patients or for health professionals; some rely on national electronic identity cards (eIDs); and others connect the smart cards to mobile phones. Quite a few e-health infrastructures are not using card-based certificates at all. Within Europe, the communication of health data across institutions and across borders (see European Directive 2011/24/EU on the application of patients' rights in cross-border health care[2]) has started with the transmission of health data via networks as opposed to data sets stored on smart cards.

Scope: Consequently, this report positions electronic health cards and biometric systems as important – although not always present – building blocks of national or provider e-health strategies. It does so by focusing on patient-centred e-health services established by governments/providers and where smart cards and biometrics are used as infrastructure enablers.[3]

[1] OECD. 2015. *Health data governance*. Paris, Organisation for Economic Co-operation and Development. OECD. 2015. *Health data governance: Privacy, monitoring and research*, Policy Brief. Paris, Organisation for Economic Co-operation and Development.

[2] <www.eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011L0024>.

[3] Good practices reported by members of TC-Health on experiences in implementing electronic health cards and lessons learned in identity management, security of information and card-based services are being accounted for.

3. Digitalization in the health domain

Opportunities and challenges of digitalization: The rapidly advancing digitalization in support of the health and wellness domains has changed the ecosystem of health-care provision all over the world. The main features of digitalization can include:

1) An increasing preponderance of digital readings, images and reports leading to fully paperless health-care documentation as an ultimate step. Digital and ubiquitously usable documentation enables in turn the realization of many improvements and innovations in health care. First of all, citizens and patients gain much easier access to their own health care, enabling the co-creation of health and health care. e-health supports more informed diagnoses, better treatment with improved follow-up, easier and more meaningful quality monitoring, optimization of processes, support for patients at home and on the move, populations in rural areas, remote involvement of health-care actors regardless of physical location (2nd opinion regimes and life-saving telemedicine intervention), overall enhanced provider collaboration and much more. "Value based health care" and "Population health" – two headlines being used in the realm of US-based accountable care organizations – mark a next step in transforming routine health and social care by integrating enhanced information into the daily practice of all health-care practitioners. The shared vision is to optimize health care – from a quality as well from an economic perspective – by continuously updating and integrating available data on the individual and the provider services.

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2) The pervasive use of mobile platforms adds another and primarily independent stream of digitalization to health and wellness: body trackers such as FitBit have become quite popular and their users generate vast amounts wellness data through them. The data are being analysed on large cloud platforms (Big Data). Health Insurance providers have become increasingly interested in using these data sets for additional insight into the preventive behaviour of insured persons and also to offer customized tariffs in the form of financial incentives that honour additional fitness activities of the insured. This in turn highlights the need for new data protection mechanisms for wellness data (as advocated in the European Commission's Green Paper on Mobile Health) and the development of a code of conduct as a measure to be subscribed to by App developers.

3) However, mobile devices have also become game-changers in their own right in the digitalization domain: Electronic Health Records (EHR) have become mostly accessible on mobile platforms such as "healthcare on the move", allowing much flexibility for health providers in their daily practices (e.g. viewing patient data on a tablet and using the in-built dictation facility for updating the record) as well as allowing easy access of citizens and patients to their health records. Mobile platforms may even serve as security tokens at the same time, e.g. enabling the sending of one-time passwords over the GSM or LTE mobile network.

As a consequence of 1–3, some health insurance providers[4] and some health-care organizations[5] have established their own "app stores" equipping their clients with mobile interfaces to administrative and health-care services as well as with tools for accessing their own EHR.

[4] e.g. *Techniker Krankenkasse,* the largest statutory health insurance in Germany, see www.tk.de.
[5] e.g. US Department of Veterans Affairs, see www.va.gov.

4. Global and European strategies for digital health

Digitalization in health/health care (also social care) has moved to the top of numerous agendas of global organizations such as the Organisation for Economic Co-operation and Development (OECD) and the World Health Organization (WHO), as well as the European Commission, national States and regions, and has stimulated the production of a vast number of policy and strategy documents. Covering them all is far beyond the scope of this report, which provides instead just some leading examples. All organizations have established dedicated web pages.

A good summary of the globally perceived potential of health IT to improve patient care is given by the Agency for Healthcare Research and Quality (AHRQ), an agency of the US Department of Health & Human Services:

> "Health IT makes it possible for health care providers to better manage patient care through the secure use and sharing of health information. By developing secure and private electronic health records for most Americans and making health information available electronically when and where it is needed, health IT can improve the quality of care, even as it makes health care more cost effective. With the help of health IT, health care providers will have:
>
> - accurate and complete information about a patient's health;
> - the ability to better coordinate the care given;
> - a way to securely share information with patients and their family caregivers over the Internet, for patients who opt for this convenience; this means patients and their families can more fully take part in decisions about their health care;
> - information to help diagnose health problems sooner, reduce medical errors, and provide safer care at lower costs." [6]

For EU policies, it is worthwhile to follow up the Digital Agenda for Europe and its partial successor, the Digital Single Market Strategy. The EU Member States have formed the e-health Network under Directive 2011/24/EU on the application of patients' rights in cross-border healthcare[7] that has defined a multiannual work plan – also reflecting national policies and as such complementary to the European 2012–2020 e-health Action Plan.

4.1. WHO: From innovation to Implementation[8]

A recent World Health Organization (WHO) report summarizes the situation:

> "Through initiatives for health sector and health information system reform, Member States are now actively building upon their nation-al foundations for e-health to deliver public health and health services in a more strategic and integrated manner."

WHO Member States acknowledge and understand the role of e-health in contributing to the achievement of universal health coverage and have a clear recognition of the need for national

[6] AHRG. 2015. *Health information technology integration*. Rockville, MD, Agency for Healthcare Research and Quality.
[7] <www.eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011L0024>.
[8] See: WHO. 2015. *From innovation to implementation: e-health in the WHO European Region*. See also the *WHO European Health Information Gateway* and the *WHO Global Health Survey* (including Europe). Geneva, World Health Organization.

policies, strategies and governance to ensure the progress and long-term sustainability of investments.

However, leveraging e-health as a national strategic asset demands a more coordinated approach to planning, implementation and evaluation. Evidence of the importance of this approach is observed through a majority of Member States developing national strategies or policies for e-health, universal health coverage or national health information systems, and ensuring sustainable funding for their implementation.

More important, however, is the recognition that successful investment in e-health requires far more than just the acquisition of technology. A holistic view of the impact and changes required to organizational processes, structures, roles, standards and legislation is needed, as well as consideration of the specifics of human resources, education, reimbursement and the culture of those who will be utilizing the e-health services – any of which can serve to derail initiatives if neglected. Perhaps the most revealing messages, echoed by the results from the survey, is the need for stronger political commitment for e-health, backed by sustainable funding, and for effective implementation of policy that is protected from frequent changes in the national political landscape.

The report is accompanied by an interactive repository of numerous figures and charts.

4.2. OECD: Focus on population-based health data analysis[9]

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Health data constitutes a significant resource in most OECD countries and it makes economic and ethical sense to use this data as much as possible to improve the health of the population and the effectiveness, safety and patient-centredness of health-care systems. Rising levels of chronic disease and multi-morbidity; concerns about the quality and safety of patient care; the need to measure and assure value for money for investments in health; and the need to allocate health system resources wisely are all too important to leave without good evidence for decision-making. Understanding the progress of the health of populations and understanding the performance and quality of health-care systems requires the ability to monitor the same individuals over time, as they experience health-care events, receive treatments, experience improvements or deteriorations in their health, and live or die.

Countries are moving forward to develop databases from electronic health records for monitoring and research. Data quality concerns include a lack of clinical terminology standards; improper coding; missing data; and variable quality across health-care providers. Unique identifiers (often supported by smart cards) are crucial to the development of longitudinal electronic health records, in order to ensure that the data within the record is complete and accurate for patients as they move among health-care providers, health insurers, and regions within their country and over time. It may also become increasingly important to identify the health-care professionals entering data into electronic health records, for purposes of ensuring and validating the completeness and accuracy of the record and for statistics related to quality, efficiency and performance.

[9] See OECD. 2013. *Strengthening health information infrastructure for health care quality governance: Good practices, new opportunities and data privacy protection challenges* (OECD Health Policy Studies). Paris, Organisation for Economic Co-operation and Development.

4.3. EU Task Force on e-health: Redesigning health in Europe for 2020

The EU Task Force on e-health[10] has delivered in 2012 a coherent vision for affordable, less intrusive and more personalized care, increasing quality of life as well as lowering mortality. Most particularly, the group has identified five levers for change that could create the momentum for a fundamental better use of existing information technologies.

- **My data, my decisions**: Patients are controllers of their own health data, with the right to make decisions over access to the data and to be informed how it will be used.
- **Liberate the data**: Governments should ensure that health data are accurate, reliable, and up-to-date; gathered in a standard way, and anonymized before being made available to anyone who can add value to it in the best interest of the patient.
- **Connect up everything**: Health care needs to reap the benefits of the digital age in order to provide more integrated and personalized care to patients, e.g. by using remote monitoring and connecting devices via the "Internet of Things".
- **Revolutionize health**: Create the necessary conditions for patients to be able to make more informed choices about where and how they want to be treated.
- **Include everyone**: The needs of vulnerable communities that are outside the reach of e-health tools need to be accommodated.

On the basis of these levers the Task Force has formulated five recommendations for policy-makers at the European and national levels to support their vision of health in 2020.

- **Recommendation I**: Most urgently, the Task Force calls upon policy-makers to act quickly to create a legal framework and space to manage the explosion of health data. This needs to put in place the safeguards that personal data are handled appropriately.
- **Recommendation II**: European and national policy-makers are invited to create a core group of Member States and regions committed to open data and e-health.
- **Recommendation III**: Policy-makers at all levels are called upon to support health literacy among patients. Health-literate patients take more responsibility for their own health.
- **Recommendation IV**: Use the power of data. Efforts are called for to overcome the "silo mentality" in primary, secondary and tertiary health institutions. Multidisciplinary teams of different actors, not all of whom are health-care professionals, are part of the future picture of health. Health institutions must publish the data on their performance and health outcomes. This information should be regularly collected, comparable and publicly available.
- **Recommendation V**: The promotion of user-driven innovation in health as opposed to technology-driven innovation is recommended. The next phase should see investment in tools that patients can use to support their well-being and manage their lives, which would close the gap between innovation and the market and between the market and patients.

[10] <www.ec.europa.eu/digital-single-market/en/news/eu-task-force-e-health-redesigning-health-europe-2020>.

5. Identity management, smart cards and biometrics as enablers for e-health

5.1. Health-care identity resources[11]

A solid foundation for health-care information management requires accurate identification of each person receiving or providing health-care services, and anyone accessing or using this information. As the health-care industry moves away from paper-based medical records that are controlled by physical access to buildings, rooms and files, an infrastructure that supports strong identity and security controls is needed.

The health-care identity management infrastructure must have a way to uniquely and securely authenticate each person across the health-care infrastructure, whether that interaction is in person or over the Internet.

Health-care organizations worldwide are implementing smart health cards supporting a wide variety of features and applications. Smart health cards can improve the security and privacy of patient information, provide the secure carrier for portable medical records, reduce health-care fraud, support new processes for portable medical records, provide secure access to emergency medical information, enable compliance with government initiatives and mandates, and provide the platform to implement other applications as needed by the health-care organization.

5.2. Smart card technologies

"Smart card technology makes use of an embedded integrated circuit chip (ICC) that can be either a secure microcontroller or equivalent intelligence with internal memory or a memory chip alone. The smart card connects to a reader with direct physical contact or with a remote contactless radio frequency (RF) interface. With an embedded microcontroller, smart cards have the unique ability to store large amounts of data, carry out their own on-card functions (e.g. encryption, mutual authentication and biometric matching) and interact intelligently with a smart card reader. Smart card technology conforms to international standards (ISO/IEC 7816 and ISO/IEC 14443) and is available in a variety of form factors, including plastic cards, fobs, subscriber identity modules (SIMs) used in GSM mobile phones, electronic passports, and USB-based tokens … Smart cards are used in many applications worldwide, including health-care applications – citizen health ID cards, physician ID cards, portable medical record cards. Over 5 billion smart cards are shipped annually. Smart card-based health-care ID cards are issued in many countries; France and Germany, for example, have issued over 140 million smart health-care ID cards to their citizens. Smart card technology is also built into every GSM mobile phone's subscriber identity."[12]

5.3. Biometric technologies

Biometric technologies are defined as automated methods of identifying or verifying the identity of a living person based on unique biological (anatomical or physiological) or behavioural characteristics. Biometrics can provide very secure and convenient verification or

[11] <www.smartcardalliance.org/smart-cards-applications-healthcare-identity>.
[12] Smart Card Alliance. 2012. *Smart cards and biometrics in healthcare identity applications*. Princeton, NJ, Smart Card Alliance.

identification of an individual since they cannot be stolen or forgotten and are very difficult to forge.

Four major components are usually present in a biometric system:

- a mechanism to scan and capture a digital representation of a living person's biometric characteristic;
- software to process the raw biometric data into a format (called a template) that can be used for storing and matching;
- matching software to compare a previously stored biometric template with a template from a live biometric sample; and
- an interface with the application system to communicate the match result.

A key social issue surrounding biometrics is the seemingly irrevocable link between biometric traits and a persistent information record about a person. Unlike most other forms of recognition, biometric techniques are firmly tied to an individual's physical traits. The tight link be-tween personal records and biometrics can have both positive and negative consequences for individuals and for society at large. In turn, convenience, improved security, and fraud reduction are some of the benefits often associated with the use of biometrics. In order to achieve these benefits for a biometrics-based authentication method, the particular biometric trait(s) must be stored remotely (centrally or distributed) in order to be available to multiple systems. Remote storage raises concerns about what security measures are in place to protect the bio-metric information, what personnel have access to the stored information, and how the individual's privacy and civil liberties are protected.

6. Short case studies for implementing e-health (card) systems

- Smart cards support security and privacy requirements, since they grant controlled and flexible access to patient data to both health-care professionals and patients. In practice, smart cards can support authentication/authorization to as well as the storage of health data. There exist two main approaches regarding the role of smart cards in health information systems. They can either be used as
- a security token, a media enabling access to a patient's health data stored on a network, i.e. to provide access to patient records stored at hospitals and doctors' offices; or
- As storage on which the medical data is stored. Data that can be stored on the smart card, besides the security token, may be patient information for use in emergency situations, such as blood type, allergies, prescribed medication, medical conditions, organ donation preferences, immunization records, etc. Typically, security of the card data is assured by mutual authentication of doctor's and patient's cards and their security keys.

In an "offline" scenario, both functionalities are provided on smart cards. In an "online" or hybrid scenario, smart cards are used as tokens for the authentication/authorisation of citizens, insured persons and patients, as well as health professionals. Since all data is online, hybrid systems may also support different levels of security – according to the sensitivity of the data involved – or support multiple forms of authentication such as one-time passwords (e.g. Denmark), mobile TANs sent to mobile phones, or other authentication methods relying on the

ubiquitous GSM smart cards. These – at a first glance – "cardless" systems based on mobile platforms are established as a convenient alternative by national health administrations.

- Health-care smart cards have been introduced in European insurance-based health systems such as in Belgium, France and Germany. The first generation of cards was used purely for administrative purposes – that is, to verify that patients are covered by health insurance and to enable doctors to generate and submit claims. A second generation of cards is being issued in many European and Asian countries. These are also used for clinical purposes.

- Many e-health strategies have recently limited the use of smart cards to authentication and authorization, i.e. using them only as tokens for the access of health professionals and/or patients to online systems managing the storage of health data.

- Other strategies avoid classical smart card/smart card reader scenarios by involving mobile platforms for authentication. Key security features of such systems are again provided by smart cards – the cards issued by mobile providers are also sophisticated smart cards. Given the extreme numbers of their production they offer, among other ad-vantages, massive economies of scale compared with the traditional scenario of dedicated readers. Currently these systems are often included as a second, alternative solution by national health administrations.

Based on a literature review as well as country data collected via an ISSA questionnaire,[13] the short cases in Annex 1 were drawn up (available in English and French only).

[13] See Annex 2 for a list of responding organizations, and Annex 3 for the ISSA questionnaire template. The questionnaire specifically focused on administrative challenges associated with the implementation of biometric and other emerging mechanisms for a successful health administration with a view to providing quality services for the insured. Issues around identity management, the kind of information embedded in the card and security features, were of particular interest.

Annex 1: Short case studies for implementing e-health (card) systems

Austria: E-card

The Austrian social insurance contains the health, accident and pension insurances. The enforcement of the Social Insurance has been given to individual corporate bodies – the insurance companies. All insurance companies are combined in the main Association of Austrian social insurance institutions. This umbrella organization is responsible for the preservation of the general interests of the social insurance and for the representation of the insurance companies regarding common affairs (e.g. conclusions of treaties with hospitals, doctors, etc.). As such, the main association is also responsible for issuing the e-card.

The e-card is a smart card which is also prepared for digital signature and therefore can also be used as a citizen card. The e-card system is the basis for the electronic administration system of the Austrian social security institutions. The e-card is personal: each individual person entitled to benefits from the statutory health insurance system receives it. It serves as the patient's proof of claim with the physician (or dentist) and has replaced all former insurance vouchers of all social security institutions. Thus, for cardholders, medical treatment has become accessible without administrative barriers and without paper documents.

Belgium: From SIS card to eID

From 1998, all beneficiaries of the Belgian social security system have used the social security information card (SIS card). The primary objective of the Carenet project, launched in 2004, is to check insurance entitlement rights of patients and allow – when possible – third-party payment. It aims to establish a 99 per cent paperless communication between insurance funds and all Belgian hospitals. Certain health-care providers such as pharmacists, and all hospitals, need to use a data access card in parallel (Security Access Module card). The SIS Card was also used for other identification purposes, but has been gradually replaced by the Belgian eID (electronic Identity Card). The eID is a unique key to access centrally stored information. Thus some of the functionality of the current social security information card (SIS card) is integrated in the eID.

The Belgian citizen eID was launched in production phase in 2004 with the goal of achieving a roll-out of 1.8 million cards per year. Total national roll-out was completed in 2009. The eID has gradually replaced other cards for general identification and authentication purposes. The Belgian eID is a smart card containing two certificates: one for authentication, and one for generating digital signatures, compliant with European Directive 1999/93/EC on digital signatures.[14] The card provides Belgian citizens with a secure identity document and an identification tool to access public and private services online. The smart card holds identity data, more specifically the identity data that are also visible in printed form on the card, except for the address of the cardholder, which is only stored in electronic form.

[14] <www.eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3Al24118>.

Canada: Towards an electronic health record[15]

In Canada, federal, provincial and territorial governments share responsibility for health care. Recent years have seen significant investments in e-health as a means to modernize and improve the quality of health-care delivery. In 2000, the *Canada Health Infoway* (CHI) was created. CHI is a not-for-profit corporation – funded from the Federal Government – whose role it is to accelerate the "development and adoption of modern systems of information technology such as electronic patient records, so as to provide better healthcare". CHI works collaboratively with deputy ministers from each of the provinces and territories, regional chief executive officers and chief information officers as well as health professionals (e.g. physicians, nurses) to fully implement an electronic health record (EHR). CHI is working towards implementing a standardized EHR that provides patient health information across jurisdictions (i.e. provinces and territories) and health-care settings (e.g. acute care, physician offices, clinics, home care, community care and long-term care). A number of key trends have influenced national spending on e-health initiatives; among such trends are an ageing population, rising consumer demands for timely and transparent delivery of health services, increased demand for chronic disease management as well as a shift from hospital-based acute care delivery of health care to home-based delivery. In addition, rising health care costs, service funding cuts and human resource shortages (e.g. general practitioner, nursing, health informatics professional) along with achieving interoperability and widespread standards adoption, and the expanded use of tele-health and telemedicine services to meet the needs of a large geographically dispersed population have influenced e-health initiatives.

Key challenges for CHI include: moving towards a baseline EHR for 100 per cent of Canadians and completing the development and implementation of a pan-Canadian public health surveillance system, increasing adoption of electronic records in general practitioner and specialist physician offices, and extending EHR adoption to community and long-term care settings, as well as facilitating patient self-care of chronic diseases using technologies.

Costa Rica: Electronic health record

The Social Insurance Fund of Costa Rica (*Caja Costarricense de Seguro Social* – CCSS) has established an e-health infrastructure with smartphones as the primary tool for authentication and authorization. This works as an alternative to electronic health cards, as the Costa Rican Department of Social Security has implemented the use of mobile applications, which can be used by policy-holders from a smartphone or tablet, and get the same information as an electronic card. While there is no initiative on the adoption of electronic health cards, institutional efforts have focused on the implementation and commissioning of the digital single health record (EHR). Further steps are dedicated to value-added components that maximize the use of digital data related to the health of individuals.

Benefits of the EHR system include the portability of the information in order to improve the delivery of services by enabling access to health information such as blood type, chronic conditions, allergies, and treatments inside and outside the institutional environment. Clinical management is improved by timely access to health data. Providers observe an impact on the simplification of procedures and optimization of institutional resources associated with the processes of providing health services to the population.

[15] Information from: Bates, D.W.; Boricki, E.M.; Newsham, D. 2013. "e-health in North America," in *IMIA Yearbook of Medical Informatics 2013*, pp.103–106.

The project has caused only minimal challenges, i.e. to review the national legislation, regulations and internal regulations related to the management of personal health information.

Estonia: Access by eID and mobile phone

Citizens and patients in Estonia can access online health data in the Estonian National Patient Portal. A new version of the portal was launched July 2013. Online access was introduced in the country at the end of 2008. The current platform allows patients to log in using their ID card and/or mobile ID.

Services available to patients in the portal include: electronic health records, links to medical images, electronic referrals, compilation and electronic signature of different types of "expression of will" , access to health insurance validity, viewing and updating of personal data and contact details of a close relative, time-critical data, viewing of ePrescriptions, tracking usage of personal data, delegating access to a trustee of personal medical data, and masking data or masking single medical documents to health-care professionals/trustees.

By 2014, more than 1.2 million persons had seen the medical documents stored in the central health information system via the Estonian National Patient Portal. Evidence collected in Estonia shows that the launch of its patient access to data service has not caused any major problems other than some initial resistance and sometimes simply the lack of digital data from the hospital sector. Use of the service is directly related to the amount of information available and the availability of services, with added value for the citizen/patient. During the first three years of the health information service deployment, most efforts were dedicated to the involvement of health-care providers and physicians, as they are considered "the source of health care data". While the lessons learned are quite positive, additional incentives are needed to achieve a more complete digital documentation in the national health information system, and hence for more data and possible applications to be available to patients.

Finland: Early adopter of eIDs for health professionals

The European Union's e-health Action Plan (COM 2004 (356)) called for Member States to draw up their national e-health Roadmaps by the end of 2006. Finland's e-health Roadmap is a continuation of the work with national strategies started in the middle of the 1990s. It gathers together the major policy definitions and achievements of the national development work from the last ten years and outlines future challenges, in particular in relation to cooperation at the European level. Finland's national objective is to secure access to information for those involved in care, regardless of time or place. Means used to achieve that objective have included a comprehensive digitalization of patient data, development of the semantic and technical compatibility of the electronic patient record systems in regard to the entire content of a record, development of the national health-care infrastructure and information network solutions, identification and verification solutions and electronic signature, and also maintaining of information that supports decision-making on the Internet. Finland has had an official e-health strategy since 1996: it contains a large number of details which would still be relevant today. It necessitated experimental legislation which permitted the sharing of data.

- In 2006, a political decision was taken to develop a national IT architecture.
- In 2007, the Finnish National Archive of Health Information (KanTa) legislation was passed. As a result, the Social Insurance Institution of Finland (Kela) – given its long

tradition of trust in Finnish society – was selected as the hosting organization and technical provider for the new digital services to the whole of Finland.

- In 2011, new legislation was formulated which permitted – inter alia – patients to opt out of the system. This new solution is much easier to handle than the obligatory opt-in foreseen in the former legislation (2007). Nevertheless, the manifold updates defined by the 2011 legislation imply many changes to be made to IT systems and have thus slowed down the implementation of the full approach a little.

The seven main elements of the Finnish e-health architecture design are:

- shared structured (standardized) electronic patient records;
- national eArchive for the electronic patient records (KanTa);
- central consent management;
- eAccess for the patients;
- ePrescription system (in operation in public scare);
- Patient Care Summary; and
- an information management System (a new element which was added in 2011).

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Results: Electronic patient records were first put into comprehensive use in local institutions. Now, electronic patient data are utilized at the regional level. Electronic patient record (EPR) distribution covers 100 per cent of both specialized care (hospital districts) and primary care (health-care centres). EPRs were used as the only source of patient narratives in more than 90 per cent of all the primary health-care centres, and in most of the hospitals. Filmless picture archiving and communication systems (PACS) are in use in all 21 hospital districts and in 94 per cent of the primary care centres. Electronic information exchange between organizations has progressed rapidly. Electronic referrals, electronic discharge letters and multilateral region-al electronic patient data depositories are common. Fully interoperable patient data exchange is regionally in operational use in most of the health-care institutions. This development has been accompanied by the intake of structured core data, national classifications and coding systems. All public health-care providers joined the national ePrescription service.

France: SESAM-Vitale 1 / 2 and health professional card

The SESAM-Vitale system uses a microprocessor card (Carte Vitale from 1998, Carte Vitale 2 since 2007) which contains health insurance data for the insured and their beneficiaries. It replaces paper forms by electronic reimbursement claims (*Feuilles de Soins Electroniques* – FSE) controlled by the simultaneous usage of the health professional (CPS, see below) and insured person's cards. Carte Vitale 2 holds a photo and additional digital functions.

Objectives: The initial driver for implementing a smart card system was to reduce administrative costs caused by delayed reimbursement of health-care expenses for the patients. It took up to two months for reimbursement to be made.[16] The overall objective of the smart

[16] Smart Card Alliance. 2006. *Sesam Vitale*. Princeton, NJ. Available at <www.smartcardalliance.org/resources/pdf/Sesam_Vitale.pdf>.

card was hence to simplify the management of medical expenditures for the French national health insurance system by changing the paper-based payment system to an electronic transfer-based system. To limit fraud was also one of the objectives.[17]

Implementation: France was one of the first countries in the world to introduce smart cards on a large scale to the health insurance system. The Vitale card, relying on a microprocessor, was introduced in 1998. A second generation card (Carte Vitale 2) – rolled out in 2007 – is now being used as a key to medical history saved in a secure server.[18] The main differences be-tween the two cards are that the second generation card has a photo of the beneficiary, and additional digital functions to transfer electronic health records in the future. In addition, the first card was for an entire family whereas the Carte Vitale 2 is for an individual only.

Information stored on the card: The smart card's microchip holds the beneficiary's basic social and medical insurance data including the individual's social security number.

Security: The smart card system requires two cards (card-to-card verification) for access to patient data, i.e. the Carte Vitale 2 for the patients and the CPS (health professional card) for health-care providers. The system is accessed via a national secured extranet. The French health professional card (*Carte de Professionnel de Santé* – CPS) provides identification, authentication, digital signature and data encryption. Besides physicians, pharmacists and many allied medical professions also receive cards. Cards for different groups of health professionals can be easily recognized by their colour. More than 425,000 cards have already been issued to health-care professionals, more than 90,000 of these to physicians.

Results and current status: The new system shortens the period of claims processing and reimbursement from two months to a few days, and enables the transfer of medical records and prescriptions electronically to the public health insurance (CNAM). Moreover, the programme has resulted in cost savings of more than EUR 1 billion per year, better control of expenditures, an increase in privacy and the possibility of building up statistics on pathologies.

Germany: E-health card (HIC), Health Insurance Card II

Back in 1995, the implementation of a first Health Insurance Card (HIC) triggered the installation of administrative IT-systems by office-based physicians. HIC was a pure memory card holding the administrative data of the insured. A reform of statutory health insurance legislation (Social Code V) in 2003 defined the new e-health Card (eHC), whose introduction was foreseen for 2006 and was finally concluded in 2013. The eHC holds a microprocessor and stores administrative data as well as certificates, cryptographic keys and medical data. The roll-out of the eHC should ultimately improve the quality, efficiency and transparency of health care. The National Association of Statutory Health Insurance Funds established in January 2005 a dedicated organization, *Gesellschaft für Telematikanwendungen der Gesundheitskarte mbH* (gematik) to support the roll-out and further development of the eHC.

Data on cards: Information types, users and access rights: eHC holds administrative data (name, date of birth, address), a photograph and the signature of the insured. The legislation also foresees the inclusion of medical data for emergency treatment and medication data. Access to

[17] Brieu, M.-A. 2014. *Carte Vitale 2 in French health insurance system.* ILC-France.
[18] Keliris, A. P.; Kolias, V. D.; Nikita, K. S. 2013. *Smart cards in healthcare information systems: Benefits and limita-tions.* New York, NY, Institute of Electrical and Electronics Engineers.
Sembritzki, J. 2004. *Use and development of health cards in Europe* (IFHRO Congress & AHIMA Convention Proceedings). Chicago, IL, American Health Information Management Association.

data on the card is strictly regulated and protected: to read medical data, health professionals need to be authenticated via card to card verification using a health professional card.

Infrastructure: Germany will implement an institution-spanning, interoperable and compatible information, communication and security infrastructure, known as e-health infrastructure (TI). TI access requires dedicated devices (decentral components), i.e. connectors and card readers. The first service to use the TI, an initial online service, is the management of data on insured persons.

Benefits: While implementation has started with administrative services, medical services are expected to provide tangible benefits for patients in the near future. These should safeguard the complete information available to physicians at the point of care and improve quality of care accordingly. Health-care providers and health insurance organizations will be the first to benefit from up-to-date insurance data (online update) and fraud prevention. Encrypted Internet access will support a higher level of privacy for patients.

Italy (Lombardy region): Access through smart cards[19]

Regione Lombardia is the governing authority in charge for the implementation of health and e-health policies and programmes at regional level. The Directorate General for Health (Lombardia) controls and manages the Regional Health-care System (*Sistema Socio-Sanitario Regionale* – SISS) and engages, through the Regional Health-care Fund, in the establishment of health-care infrastructures. The IT-infrastructure empowering the Regional Health-care System is the CRS-SISS project which has at its core a "Health-care Extranet" linking professionals, social services, organizations and citizens, tracking all the events which occur in the treatment of patients and providing value-added services. CRS-SISS is based on smart card technologies, ensuring access to the network for both citizens and health-care providers through their personal smart cards.

The citizens' smart card allows:

- identification and authentication;
- access to public administration services; and
- certification of the "presence" of the citizen (through electronic signature of documents).

The professional smart card enables:

- identification and authentication;
- authorization to access the system; and
- electronic signature.

Lithuania: Electronic health records

The start of the Lithuanian e-health system, in common with other complex information systems, is gradual and with transitional periods. Following the legislation, certain health-care institutions (HCI) are required to handle data relating to patients' health care electronically in

[19] Some information in this section is from <www.netcards-project.com/web/partners>

accordance with the procedure laid down for the use of the Health Services and Cooperation Infrastructure Information System (ESPBI IS). Full use of the e-health system in all health-care institutions is planned to become compulsory from 2018. According to the plan for the implementation of the E-health System Development Programme for 2009–2015, about 170 HCI have already implemented the projects for e-health development information systems and have begun the electronic completion of patient medical records within the scope of the project. This involves 12 clinical forms: referrals, epicrisis, description of visits, e-prescriptions, descriptions of research, etc., as well as eight medical certificates: health certificates for students, drivers, holders of weapons, birth or death certificates, and others.

ESPBI IS meets the highest security requirements. Information about the patient's health can be seen by the patient on logging to the account using an electronic signature or through electronic banking. Information can be seen by a doctor treating a patient only if the patient is registered to receive the services of HCI. If the patient is not registered in HCI, access to data is not provided. Patients may indicate in their e-health account another person or persons who can represent them, by providing the personal identification number, name and surname of the person concerned.

Benefits: The central e-health system is capable of storing patient information from various HCI in one e-health history (One Resident – One EHR). This makes it possible to re-use health records, to avoid duplication of diagnostics procedures and provide health-care services to patients more efficiently and safely, and of better quality. This system is useful to both doc-tors and patients. Doctors will save time when filling out patients' documents, registering them for consultation or treatment, searching for information in e-health history. Patients will be better informed as they will be able to safely reach their e-health history online. The system will enable disease prevention and health promotion programmes to be carried out more effectively, based on objective records which will be available for re-use. Electronic prescription will facilitate the prescription process; e-prescriptions will be clearer, more precise and readable; pharmaceutical professionals will be able to evaluate and dispense prescriptions more easily; and patients will be able to see their e-prescriptions in their accounts on the electronic health portal, including how and what medications to use. Patient data and medical images will be stored in a subsystem of the central e-health system MedVAIS (Central PACS). The 170 HCI that have already implemented the e-health information system development project are currently starting the electronic completion of patient medical records provided in the project. Services created during projects will increase the speed of exchange of health data and facilitate work without duplication of data entry, thus enabling doctors to be able to devote more time to patients.

Malta: Generic eID[20]

The Ministry for Health has decided to use the national electronic identity system (online account and/or card) for the purpose of identification and authentication of Maltese citizens, including for health care. The means that the functions for which other jurisdictions use an "e-health card" are carried out by information systems which are accessed through the national electronic identification system. The e-ID card in Malta is a "chip and pin" plastic card. Its chip stores an electronic copy of the eye-readable (MH: I think there's a more correct term for this

[20] For further information see the following: Identity Malta, myGov.mt FAQ, MITA, and the Maltese eID integration document.

(optically readable?) but can't be sure what it is!) data printed on the outside of the card (e.g. ID number, surname, first name) and two digital certificates.

Mexico: Electronic health card

Phase 1: Limited distribution through *Seguro Popular* [21]

Mexico has a large population of 107 million inhabitants. The *Seguro Popular* programme is a government health-care initiative with broad political support. It aims to provide social security benefits to underprivileged members of the population. In place since 2004, it is considered the basis for the wider implementation of social support throughout Mexico. The programme provides subsidized medicine and medical care for inhabitants receiving no health-care benefits. The scale of the project was one of the first challenges to address. To set up a system that was able to support millions, there was a pressing need to establish a means of identification that was portable, secure, auditable and usable, especially addressing individuals with no bank account. It was also essential to find a way to eradicate fraud from the start.

In addition, the project was under strong scrutiny. For the Mexican Government, the *Seguro Popular* project was the first step in a larger new countrywide e-healthcare programme aiming at securely storing patient information, ensuring that citizens could receive the correct health-care benefits, and reducing paper-based administration.

Solution: As part of this objective, *Seguro Popular* began implementation of an e-health care smart card-based solution in early 2006. All families in the programme received a card for use by the whole household. The head of the household was clearly identified on the front of the card, with the list of beneficiaries on the back, thus covering the people in the programme. Each time a cardholder visited the doctor, important patient information could be securely accessed and additional medical information added in real time, thus reducing fraud and the costs of administration.

Sealys Health Insurance Cards – first deployed in March 2006 – hold an e-purse, patient information and prescriptions. The information can only be read by authorized health-care professionals using a card reader. This ensures privacy of confidential data and better control over health-care payment and subsidies. The smart card includes high security features such as UV printing, laser engraving, guilloche, rainbow effects, etc. These enhanced security features make the card virtually impossible to alter, forge or duplicate.

Results: In the first six months of 2006, 3.7 million smart cards were delivered to *Seguro Popular*. Mexican patients, health-care professionals and the *Seguro Popular* organization noticed benefits through cost reduction, secure personal data and the correct distribution of health-care rights to Mexicans.

Phase 2: All Mexican Social Security Institute (IMSS) beneficiaries

From 2006 to December 2011, via the Program for Modernization of the Administration of Beneficiaries and Benefits (through the subprogramme Accreditation Beneficiaries of the Mexican Social Security Institute – ADIMSS), IMSS issued smart cards with these characteristics to all beneficiaries:

[21] In the past, *Seguro Popular* was a smaller project covering a limited part of the population.

- information contained in the credentials: on the obverse, the institutional logo, elements of microprinting, security screen, data area, social security number, photograph, Unique Key Population Registration (CURP), entitled Quality and signature; and on the reverse, the standard two-dimensional bar code PDF417, legend and reference to related website;

- identification method consistent with the method of enrolment of FIEL (electronic signature) of the Tax Administration Service (SAT); and

- Identification process conducted according to the standards of the National Population Register (RENAPO).

ADMISS issued 24.1 million credentials to beneficiaries and has a bank of 747 million images: biometric (10 fingerprints), facial photograph, birth certificates, proof of address, only registrants of the national population register (CURP), among others. Recently, from June to December 2015, a credential process was conducted for 62,272 patients with chronic renal failure who were diagnosed at the time. This programme will serve as an aid in the management of identity and will control spending on hemodialysis comprehensive medical services, automated peritoneal dialysis (APD) and continuous ambulatory peritoneal dialysis (CAPD), internal and surrogate. As a result, visits to 225 medical units nationwide by 55,450 enrolled patients have been achieved, representing 89 per cent of the nominal census.

Benefits expected from the perspective of the patient:

- ensuring the health-care unit to which the patient is entitled;

- speed in procedures; and

- identification document to the Institute, which can be used for any face processing required.

Benefits expected from the perspective of health-care providers (hospital, doctors, etc.):

- identification of the patient and quick access to the provider's identifying information and social security number (SSN); and

- identification of the status of the patient at the Institute in terms of enforcement of rights to receive the service.

Benefits expected from the perspective of health insurance (social security) organizations:

- records kept of patients who belong to the organization and who are within the registry of patients with chronic renal failure;

- identification of patients who are in a state of delicate health;

- swift access to identification data; and

- control of expenditure to ensure only authorized paid sessions and prevent identity theft.

Slovenia: Old/new health insurance cards, health professional cards

The Health Insurance Institute of Slovenia (HIIS) was established on 1 March 1992, and is the sole provider of the compulsory health insurance in the country. The Slovene health insurance

card was introduced in 2000. The system provided insured persons with a smart card and set up data links between the health-care providers and health insurers (Health Insurance Institute and two voluntary health insurance providers). The health insurance card is an official identity document of persons insured under the compulsory health insurance scheme. The card is issued by HIIS (ZZZS in Slovenian). The insured person must submit the health insurance card when visiting a doctor and claiming or enforcing health-related rights. The card enables a simple and fast data transfer among insured persons, insurance companies and health-care professionals.

In submitting the health insurance card, the insured person allows health-care professionals electronic access to information on:

- the insured person (name and surname, address, gender, date of birth);
- persons subject to payment of contributions (registration number, title, address, type of contribution payer);
- compulsory health insurance (validity of insurance);
- voluntary health insurance (the insurance company, type of insurance policy, validity of insurance);
- chosen personal physicians (general practitioner or paediatrician, dentist, gynaecologist);
- prescribed medical devices;
- prescribed medication;

- maternity procedures and procedures of artificial insemination; and
- commitment for voluntary post mortem organ and tissue donation for transplantation.

This data is kept by HIIS, with the exception of data on voluntary health insurance, which is kept by the voluntary insurance companies. Data kept in the records of HIIS and voluntary insurance companies are protected against unauthorized access in such a way that only holders of health professional cards (owned by health-care professionals and other authorized workers) can read them. It is only possible to access the information by using the health insurance card and the health professional card at the same time. Access to information is impossible without the health professional card; it is only possible to access data without the health insurance card in events when the card doesn't work, or when the insured person proves his/her medical insurance with a temporary written certificate, or in an emergency situation. Even in such cases it is impossible to access certain sensitive personal information.

Different groups of health-care professionals have different access rights. For example, an administrative worker can only access administrative information, while a doctor or pharmacist can access information about medication prescribed to the insured person. A complete authorization scheme for different groups of health-care professionals was approved by the Republic of Slovenia National Medical Ethics Board. Data operators keep records for all accesses to information on insured persons according to the rules in force.

The front of the card is designed with visual images, which provide visible information. The back side of the card provides brief handling instructions. Special cards have been designed for

bilingual regions, with equivalent presence of both statutory languages, Slovene and Hungarian or Italian.

The card includes the following electronic information:

- identification number of the health insurance card holder (HIIS number);
- date of issue of the health insurance card; and
- name and surname of the health insurance card holder.

From 2006, HIIS began to introduce the so-called online system (direct access to insurance and health-related data) and to upgrade the Slovene health insurance card system in the scope of which a smart chipcard is to become merely a key to the informatized databases and will no longer be a carrier of data. Health insurance cards made after November 2008 also include a digital certificate with which the insured person allows health-care professionals to access data in back-office through the online system.

The annual volume of health insurance cards is 106,000 (births, replacing lost and destroyed cards, changes of name, etc.). There are over 2.1 million health insurance cards in use.

Health professional cards provide their owners with permission to access information they need for work and information for which they have authorization. Doctors, nurses, administrative staff at reception offices, pharmacists, physical therapists, and other health-care professionals possess it. Approximately 25,000 authorized health-care professionals have a professional card. The technical features of a health professional card are the same as for the health insurance cards.

Certification authority of digital ZZZS-CA certificates: HIIS has established a private/public key infrastructure (ZZZS-PKI), within which the certification authority for digital ZZZS-CA certificates operates for the needs of the health insurance card system. The ZZZS-CA Certification Authority works as a closed system and issues standard (unqualified or normalized) digital certificates for health insurance cards and health professional cards.

Switzerland: Health insurance cards, EHR upcoming

Switzerland has issued a modern health insurance card since 2010. The cards hold primarily administrative data, but may hold some health-related information in the future. The standard smart card is seen as a first step towards an e-health card and is issued to all insured persons in Switzerland. The primary objectives are to simplify reimbursement of health-care providers by health insurance organizations and to store medical emergency data.

An earlier Swiss e-health strategy was approved by the Government in 2007. The core goal of this was to establish an Electronic Health Record system for all citizens by 2015. This ambitious deadline has been missed, but it fosters and leverages the culture and understanding of the challenges in health care. lt lists greater efficiency, quality, safety and economic performance as the overriding strategic objectives of e-health:

- E-health creates added value by improving the coordination of players and processes.
- The processes and procedures in the complex Swiss health system are fragmented, due to the federal structures and the fact that some players operate as small businesses and this

leaves the processes prone to errors. End-to-end electronic processes can help to reduce errors and save lives.

In January 2013, the Swiss Federal Council approved "Health 2020", a comprehensive strategy comprising a total of 36 measures across all areas of the health system with the aims to maintain quality of life, increase equal opportunities, raise the quality of care and improve transparency. E-Health services are a significant element of the Swiss Health Strategy 2020:

> "E-health tools can improve the quality of care and patient safety by giving all healthcare professionals access to relevant information and patients' records at all locations and times. In this way e-Health contributes to greater efficiency by avoiding duplication of diagnostic procedures. Great attention must be paid to protecting personal data when implementing e-Health. E-health can intensify the coordination be-tween all stakeholders in the treatment process. This benefits patients, particularly those with complex chronic diseases. These improvements in quality will also reduce costs in the medium and longer term. E-health is an important element in moving forward healthcare reforms designed to have an impact on quality and costs.
>
> The major measures relating to e-health are:
>
> - Introduce and actively promote e-medication, giving doctors, pharmacies and hospitals electronic access to information about patients' medication. Increase patient safety by reducing errors.
>
> - Introduce and actively promote the electronic patient dossier in order to increase the quality of healthcare provision and patient safety and to support treatment processes and collaboration between service providers.
>
> - Provide digital support for treatment processes – such as hospital discharge pro-cesses or integrated management processes throughout a treatment plan – using the electronic patient dossier to provide the necessary data."

Taiwan (China): Electronic health card

The Taiwan (China) health-care smart card project is one of the largest health-care smart card solutions in the world. Ninety-six per cent of Taiwan (China) citizens are part of the National Health Insurance (NHI) programme, with a total of 16,558 hospitals and clinics (90 per cent of the total) creating a service network for insured applicants nationwide.

Background: The paper-based health insurance system of Taiwan (China) had in the past encountered problems including identity fraud, excess false claims and waste of resources caused by frequent renewal of health cards. Before the smart card was introduced, paper cards were used by the Bureau of National Health Insurance (BNHI) to audit patient information, then reimburse service providers monthly. The card was renewed after the patient used medical services up to six times. To tackle the challenges, the project of the Government of Taiwan (China) for smart card implementation started in 2001 to improve quality of health insurance such as increase of efficiency in the health-care system, and reduction of fraudulent claims and administrative costs.[22] The Bureau of National Health Insurance (BNHI) issued 22 million

[22] See Li, Y.-C (Jack). N.d. *Taiwan HIT case study*. Seattle, DC, National Bureau of Asian Research.
Lee Min-Hyung, T. n.d. *Comparative study of Taiwanese health care system*.
Smart Card Alliance. 2005. *The Taiwan health care smart card project*. Princeton, NJ, Smart Card Alliance.
GlobalPlatform. N.d. *Smart cards in public health care: GlobalPlatform Smart Card Technology implemented to*

smart health-care cards using Java. The smart card project infrastructure is integrated into the original paper-based health-care system.

Expected outcome: The project is expected to help prevent fraudulent claims, reduce administrative costs, and shorten duration for reimbursement.

Implementation and development: The smart card project by the National Health Insurance Administration (NHIA), a government agency under the supervision of the Ministry of Health and Welfare, began from April 2001 to May 2003. The budget for the project was around USD 10 million, and the project itself – which has become one of the most innovative e-health projects – includes design, manufacturing and distribution of IC cards and readers for all citizens and health-care providers, respectively. Another requirement of the project includes the establishment of a computer network for NHIA HQs, operation of the system and training related personnel.[23]

Information included on the card: The smart card includes information on each cardholder, health insurance, medical treatment and public health administration. Personal information includes name, date of birth, photo and ID number. Information on health insurance includes eligibility, premiums, number of visits and admissions, use of preventive programmes, and health-care expenditures. Information on medical treatment includes drug allergy history, chronic disease prescriptions and treatment. Information on the public health administration includes personal immunization chart, allergy notations, and consent for organ donations.

Privacy and security: Strong measures to enhance privacy and security have been employed such as high-grade card printing, encryption of sensitive personal information, mutual authentication process to access on-card data, and personal identification numbers.

Results of the project implementation: The project resulted in the following: daily upload of records from health-care facilities to the insurer, which enables the insurer to trace epidemic suspects in times of outbreaks; monitoring of daily activities of the providers for better budget management; and reductions in administrative costs.

Tunisia: Electronic health card

The project to introduce the electronic health card is in the phase of tendering. Its implementation was scheduled for the end of 2016 but will be delayed to the beginning of 2017. This decision is motivated primarily by the need for:

- treal-time tracking of consumer care and avoidance of exceeding budget limitations in the context of the private sector;
- security of the health insurance system to fight against fraud and abuse;
- digitalization of the information flow between the public health insurance (CNAM) and service providers as well as the social insured, and reduction of administrative costs by making the system paperless;

optimize the quality of delivery and efficiency in Taiwan's health care system (Case study). Redwood City, CA, GlobalPlatform.

[23] Email interview (2 February 2016) with Ms May Wang, Associate Researcher, NHIA.

- mastering the health insurance cost expenditure through sound management and in real time (or with a slight delay) of the flow, and a close tracking of expenses; and
- improving the quality of services provided to the social insured and health-care providers including overcoming delays.

Information stored on the card is administrative information such as:

- unique identifier;
- identity of the insured and dependants (name, date of birth);
- remaining budget;
- assessment of rights; and
- care sector.

The system will be based on a classical computer infrastructure (central servers and database), reading terminals and update maps (electronic banking), PKI to sign transactions and secured networks

Benefits for patients include their entitlement to care services in real time; the authentication of beneficiaries, materialization of contact and consequently fighting fraud and bogus consultations; budget monitoring for common illnesses in real time; reducing reimbursement delays; and the option of being granted online consent for health care requiring prior agreement of the CNAM.

Benefits for health-care providers include strong authentication of beneficiaries; rigorous monitoring of budgets; tracking of beneficiaries; and ePrescribing and electronic billing. The CNAM will benefit from monitoring expenditures.

Turkey: Biometric identity verification system[24]

Background: Following failure of a first attempt to implement a health insurance card, the standard ID became the only method to proof insurance status from 2008 in Turkey. Fraudulent claims underlined the need for a secure system, which was implemented from 2012.

Objectives of the system: Major objectives of the system are to provide health-care services for the right beneficiaries and prevent improper payments through a secure electronic infrastructure such as palm vein scanners.

Expected outcome: The system is expected to significantly reduce improper payments through a biometric identity verification system which enables exact identification of the beneficiaries of the social security system.

Implementation: The system has been introduced to private and university hospitals. Within one month from October to November 2012 the system was introduced to 20 of the

[24] See ISSA. 2013. *Biometric identity verification system. A case of the social security institution*. Geneva, International Social Security Association.

81 provinces. The remaining provinces were covered within less than five months from 15 November 2012 to 1 April 2013.

Identification of eligibility: Identification of eligibility is carried out by checking (scanning) whether the image of under-skin vein pattern corresponds with the individual palm vein of patients.

Security: Copying individual palm veins or manipulation of the system is almost impossible, since biometric information such as palm vein – is not the same image as fingerprints – is highly complex, and recorded data of individual palm veins are encrypted three times using AES 256 bits.[25] Not even staff of the Social Security Institute can have access to the recorded data to identify whose vein patterns belong to whom. Recorded data can be accessed only when the patients get their hands scanned at the health-care facilities.

United States: Meaningful use[26]

The US health-care system is highly decentralized, and most care is reimbursed on a fee-for-service basis. The Federal Government exercises much of its influence on health care through Medicare, which pays for most health care for those over 65 through the Center for Medicare and Medicaid Services (CMS). Support for Medicaid, which covers the poor, disabled and unemployed in the United States, is divided between the states and the Federal Government.

In 2009, the United States established the Office of the National Coordinator for HIT (ONC) under the auspices of the American Recovery and Reinvestment Act (ARRA). ONC has developed a formal plan for advancing the use of HIT. The rationale for increasing its use is that it is expected to improve the safety, quality and efficiency of health care. Moreover, the HITECH initiative, passed as part of the stimulus package, included USD 36 billion in spending on Medicare and Medicaid incentives for providers for the "meaningful use" of electronic health records. The concept of meaningful use was developed to incentivise interoperable solutions that will improve care. Development of e-health applications in the United States is nearly all carried out in the private sector, primarily by the vendor community, with the exception of the Veteran's Administration hospitals, in which the Government has sponsored the development of the applications to date. The role of the federal system has been seen as to promote agreement on and identification of specific standards and coordination of activities. The broad notion of the National Coordinator's Office under the HITECH Act has been that a combination of national coordination, grant programmes in specified areas, enhancement of trust by providers, and payment incentives for providers will together advance the "tipping point" of e-health adoption. The main barriers to HIT adoption before have been the US reimbursement approach; issues around privacy, confidentiality and security; and a lack of interoperability for clinical information.

"Meaningful use" is a core concept with five policy priorities: (1) to improve quality, safety, efficiency and to reduce disparities; (2) to engage patients and families; (3) to improve care co-ordination; (4) to improve population and public health; and (5) to ensure adequate privacy and security. Eligible providers and hospitals can receive substantial financial incentives if they adopt HIT. The meaningful use criteria are being developed through a public process which is led by a federal committee called the HIT Policy Committee in concert with the HIT Standards Committee which is addressing standards. The criteria then go to the Office of the National

[25] AES 256 bits is the most advanced encryption algorithm and highest encryption key length in the world.
[26] See Boricki, Newsham and Bates, op. cit.

Coordinator, which in concert with the Department of Health and Human Services and the Center for Medicare and Medicaid Services converts them to criteria suitable for payment. They are made available for public commentary and revised before being finalized.

Providers and hospitals have been very successful in certifying for the 2011 criteria; all the hospitals and approximately 98 per cent of eligible providers who have attempted to certify have qualified. It appears that primary care providers in particular appear to be adopting rapidly.

The qualitative reaction has been mixed with respect to the speed of the process, though there appears to be broad support for the general direction. Vendors and providers have expressed important concerns about the speed, and have requested that it be slowed down, while patient groups and the payer community have encouraged the ONC to proceed at the current pace.

Broadly, the programme is extremely comprehensive, highly ambitious, and the overall returns about its performance have been extremely positive. Some of the concerns that have been raised include whether the meaningful use programme will have unintended adverse consequences, for example by diverting vendors' attention to unimportant areas because of the "list" approach which is being taken; whether the regional extension centres have enough support to help all the providers who need support; whether small practices and rural hospitals will be disadvantaged; and whether any of the programmes will be sufficient to enable broad data exchange. An overarching concern is whether the Federal Government will continue to supply needed support for these efforts, but the programme thus far has enjoyed broad bipartisan support.

Viet Nam: Electronic health card

Viet Nam Social Security has a plan to introduce e-Health cards in the period 2017–2020. The data stored in the cards will include basic information on the cardholders (full name, date of birth, ID number, gender…) and the latest transactions including the most recent medical treatments.

Social security institutions, registered health-care providers and cardholders will have access to the data, while other relevant authorities may have the right to access the data on a case by case basis.

The national centralized database and the national ID numbers system will be developed with e-card management software and related ICT facilities in order to implement the e-health insurance card. Patients will benefit from easier and faster access to the various health services, enjoying value-added services integrated in the card. In addition, they can easily check their treatment information and valid period of coverage. Health-care providers will be able to manage the medical records of patients and transfer the data needed to the health insurance institute for reimbursement purposes, with faster processing of all transactions related to insured patients. The social security institution will benefit most from the e-health cards system, including through better management of the HI scheme, effectively controlling and detecting defaults and abuse, providing quality services to its members, improving health-care performance, increasing public trust in social security institutions, and supporting internal management, the decision-making process and policy improvement

Further development: The e-health insurance cards will be integrated into the social insurance system, thus developing into a social security cards for all social security services.

Annex 2: List of ISSA members returning questionnaires

Aruba	Social Insurance Bank *Sociale Verzekeringsbank*
Belgium	National Institute for Health and Disability Insurance *Institut national d'assurance maladie-invalidité*
	National Union of Socialist Mutual Benefit Societies *Union nationale des mutualités socialistes*
British Virgin Islands	Social Security Board
Costa Rica	Social Insurance Fund of Costa Rica *Caja Costarricense de Seguro Social*
France	National Sickness Insurance Fund for Employees *Caisse nationale de l'assurance maladie des travailleurs salariés*
Germany	National Association of Statutory Health Insurance Funds *GKV-Spitzenverband*
Lithuania	State Social Insurance Fund Board of the Republic of Lithuania under the Ministry of Social Security and Labour
Malta	Ministry for the Family and Social Solidarity
Mexico	Mexican Social Security Institute *Instituto Mexicano del Seguro Social*
Tunisia	National Health Insurance Fund *Caisse nationale d'assurance maladie*
Viet Nam	Viet Nam Social Security

Annex 3: Questionnaire on electronic health cards/e-health

The purpose of this questionnaire is to identify members' experience with the implementation of e-health cards. It will provide information for the development of a report by the ISSA Technical Commission on Medical Care and Sickness Insurance on the optimization of information systems to strengthen health systems stewardship and health-care performance.

Information provider/Health insurance organization

- General information
- Name and address of the organization
- Full name / Position /E-mail / Telephone (of respondant)

Timeline and strategy

When did your organization introduce e-health cards or are you going to introduce e-health cards in the near future? Why have you decided to do so?

Data on cards: Information types, users and access rights

What kind of information is stored on the card and who can access the data?

Infrastructure to implement the e-health card

What kind of infrastructure is necessary to implement the e-health card?

Benefits to be expected from the card

(a) Benefits expected from the perspective of the patient?

(b) Benefits expected from the perspective of health-care providers (hospital, doctors, etc.)?

(c) Benefits expected from the perspective of health insurance (social security) organizations?

Challenges

The challenges section examines the legal, administrative and technical challenges encountered when introducing identity management tools such as electronic health cards, and how they were met.

(a) Legal aspects (enabling legislation, protection of privacy, etc.)

(b) Administrative, contractual and funding aspects (who paid for what, service level agreements, etc.)

(c) Technical aspects (technology used, interoperability)

How do you envisage developing the system further?

Additional comments, references for further reading, etc.

Annex 4: Examples of smart health-care card deployments

Table 1. *Examples of smart health-care card deployments*

Country	Name / Launch	Data on card (besides name, etc.)	Services	Numbers
Algeria	CNAS (2007)	n/a	n/a	7 million
Austria	e-card (2005)	e-Prescription	e-Prescribing Insurance check e-Referral	11 million (insured) 24,000 (HPC)
Australia	Medicare Smartcard (2006)	n/a	n/a	40,000
Belgium	Social Identity System – SIS, now eID (1998 / from 2004)	Health insurance eIdentity	e-Prescribing Insurance check e-Referral	11 million
France	Carte Vitale (1998) Carte Vitale2 (2007)	Health insurance Emergency data Medication for chronic diseases Emergency contact	e-Prescribing Insurance check EHR	60 million
Germany	Gesundheitskarte (e-health card) 2011	Insurance status Emergency data Medication scheme	Insurance check Medication log EHR, e-Referral	72 million insured 5,000 HCP
Italy, Lombardy Region	Carta Regionale dei Servizi (Regional Service Card (CRS), 2004	Informational Health insurance Emergency data	e-Prescribing Insurance check EHR, e-Referral	3 million
Kenya	MediSmart C. 2007	Fingerprint bio-metrics, NFC	Enable access to medical services	300,000
Mexico	Sealys HIC, Seguro 2006	Health insurance	Insurance Check e-Prescribing, EHR	3,7 million
Slovenia	Health Insurance card (HIC), 1999	Emergency data	Insurance check	2 million (insured) 70,000 (HPC)
Spain	Carte Santé (1995)	n/a	n/a	5,5 million
Taiwan, China	National Health Insurance Card, 2002	Emergency data Chronic diseases Medical information	e-Prescribing Insurance check EHR	24 million (insured) 150,000 (HPC)
United Kingdom	NHS Connecting for Health (HPC)	n/a	n/a	1,2 million (HPC)