

# Electronic Health Book—a unique Czech solution for eHealth

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**Abstract** In the last few years, electronic healthcare has become a phenomenon that is being widely discussed by both patients and physicians. The Electronic Health Book (EHB) system, a unique Czech solution for eHealth, is developing dynamically in the Czech Republic. EHB is a highly secure overview of a patient's health and medical information in electronic form, accessible 24 h a day via the Internet. At the same time, it is a safe environment interconnecting healthcare service providers, patients, and health insurance companies. It serves to transfer medical information between the physician and the patient and amongst physicians. In emergencies, it can help save lives. It significantly improves the quality of care received by patients; at the same time, it improves the efficiency of the care provided and allows for savings throughout the healthcare delivery process. Thanks to its comprehensiveness and immediate accessibility, the system is very highly rated in the European Union, which has chosen it as its reference project. The EHB system is a unique patented service that was registered in 2002 with the Industrial Property Office under patent No. 297 879 “Method of compiling, recording, and retrieving information about healthcare and healthcare results, and its use”.

**Keywords** Electronic Health Book · Patient's health data · eHealth

The idea to develop a modern electronic health information exchange and sharing system in the Czech Republic that

would improve the quality of healthcare delivery, significantly enhance the transparency and effectiveness of healthcare, and put more power in the hands of the patient dates back to 1999. The system was founded by three doctors: Pavel Hronek, M.D., Miroslav Ouzký, M.D., and Milan Cabrnach, M.D. The idea was initiated specifically due to the complaints of health insurance companies regarding the necessity to reimburse unnecessarily repeated laboratory testing.

In their discussion on the vision of the method of operation of the system, the founders identified four basic philosophical principles that to date have remained the cornerstones of the Electronic Health Book (EHB): (1) the patient has the right to see all information that forms part of his medical records; (2) only the patient may decide to whom he provides access to this information; (3) it is primarily the patient who is interested in having the information at the right place—where decision-making regarding the healthcare to be provided to him takes place and where he is present—at the right time; and (4) involvement in the information handover system must be voluntary, based upon the active consent of both the patient and the healthcare professional.

A legislative opt-out solution, where the patient provides his consent with data processing, was considered as well. The principle of voluntary participation in the system has prevailed, as enforcement through the law would not be appropriate in respect of medical professionals.

## 1 A brief history of the Electronic Health Book

Since its inception, the Electronic Health Book was developed to be “patient-centred”, the key role being given to the patient. This was reflected also in the original name used for the project until 2008—IZIP—which stands for

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“Internet Access to Patient Medical Information”. Another key role within the system rests with the doctors, for whom the system is also beneficial in terms of providing them with necessary background information. The system is also a suitable instrument for health insurance companies. In the beginning, the system was offered to all health insurance companies operating in the Czech Republic. The General Health Insurance Company (VZP) showed interest in the EHB, under the condition that it obtain exclusivity. Hence, the benefits of the Electronic Health Book were taken on by the General Health Insurance Company—the largest insurance company in the country and the market leader in the Czech Republic—and the EHB became an exclusive service for its clients. Thereafter, the first pilot projects commenced. Testing of the system began in 2001, initially in two districts of the Central Bohemian Region. One year later, the system was disseminated to other regions, and a further 469 healthcare facilities became involved. Since 2003, EHB has been officially operating all over the country and has been joined by a further 1,300 healthcare facilities. A major increase in the number of users of the EHB system and registered healthcare professionals was seen in 2009–2010, when the system was joined by more than 25% of the population of the Czech Republic (approx. 2,400,000 insured) and more than one third of all doctors.

Figures for the Electronic Health Book system (as of 8 March 2011) [12]:

Users	2,527,542 (of 10,470,000 inhabitants in the Czech Republic)
Healthcare professionals	18,720 (of 44,381 healthcare professionals in the Czech Republic)
Hospitals	101 (of 191 hospitals in the Czech Republic)
Healthcare facilities	8,018
Records in EHB	18,665,542

## 2 A unique patent

The way the Electronic Health Book functioned was so unique that its authors successfully applied for a patent. In 2002, it was patented by the Industrial Property Office under patent number 297 879, under the title “Method of collecting, registering, and providing information on healthcare and its results and the application of this method”. In the Czech Republic, there is no other adequate system for sharing information in real time between the doctor and the patient and among doctors themselves.

The principle of the invention is as follows: the client and the healthcare professional (or healthcare facility)

register in the central registry, which automatically verifies this registration process. Once it is approved, the registered receives an access statement and is saved in the central registry. The user then logs into the system using the selected authentication tools. Information on healthcare and its results are recorded into the system following automatic verification of the client’s registration. This information, entered into the system by the healthcare provider, is automatically uniquely linked to the client and, at the same time, the information (or parts thereof) is made available solely to the client and, upon the client’s authorisation, to healthcare professionals.

## 3 Situation in the Czech Republic

After 1989, the Czech healthcare system began transformation from the state-controlled model to the general health insurance model, where the main responsibility for the funding and organisation of healthcare was taken over by health insurance companies. Immediately after the political changes of 1989, work on preparation of the new healthcare system design commenced under the auspices of the Ministry of Health (MoH), the essential principles of the concept being as follows:

- The state shall guarantee adequate healthcare to all citizens.
- Healthcare shall be provided in a competitive environment.
- Citizens shall have the right to freely choose their doctor, healthcare facility, and their health insurance company.
- The monopolistic position of state healthcare shall be eliminated; healthcare for the public shall be provided regardless of the type of ownership of the healthcare facility (state, municipal, church, or private).
- The essential feature of public healthcare shall be an independent healthcare facility with its own legal personality.
- The focus of therapeutic care shall be on outpatient (especially primary) medical care.
- Healthcare shall be funded from multiple resources (the state budget, health insurance, municipal funds, corporate funds, personal funds, etc.).
- Mandatory health insurance shall be an integral part of the healthcare system.

Privatisation of Czech healthcare started in 1992. The private sector was significantly enhanced in 1993. The commencement of privatisation resulted in a rapid increase in the number of healthcare facilities (including independently operating private doctors). While less than 8,000 of them were registered in 1989, by the end of 1993 their number exceeded 17,000, and by 2000 it was 25,000. In 2009, there were almost

28,000 healthcare facilities in the Czech Republic, employing almost 45,200 doctors and 106,800 non-medical healthcare professionals.

In late 2009, there were less than 106 beds per 10,000 inhabitants in the Czech Republic (including 60 beds in hospitals, less than 21 in specialised medical institutions, and 25 in spas). From 1989 to 2009 the hospital bed capacity dropped by 26%. Concurrently, a trend was seen where inpatient bed capacity was being transferred to follow-up nursing care in facilities with fewer beds or in facilities incurring losses. With a view to the progress in medicine and the ageing Czech population, it may moreover be expected that the trend of increasing numbers of nursing beds with decreasing acute bed counts will continue in the future.

The discrepancy between the largely growing number of healthcare facilities and the drop in the total number of beds, which may seem illogical at first, was caused by the growing number of small healthcare facilities and private practices that opened shortly after market principles were introduced in the country. Any new private practice is officially considered to be a healthcare facility, regardless of its bed capacity (this explains the increase in the total number of healthcare facilities). The number of beds began dropping because healthcare was provided particularly in large hospitals, which usually incurred economic losses and, which, moreover, were not subject to market principles, as they were financed by the state.

In the early 1990s, there were less than 20 outpatient doctors per 10,000 inhabitants; in 2000 that figure was as high as 27. Recent years have also seen an increase in the numbers of outpatient doctors, but this increase has not been as dramatic as the previous one. In 2009, there were almost 31 outpatient doctors per 10,000 inhabitants. The staffing of outpatient care has been exhibiting a continuously growing trend. A major increase in the number of outpatient doctors occurred as a result of the privatisation and fee-for-service form of healthcare financing from health insurance funds, particularly in the period from 1992 to 1997.

### 3.1 Legislative background

In 1992, the Act on General Health Insurance and the Act on the General Health Insurance Company of the Czech Republic came into force. In July 1992, the Act on Departmental, Professional, Occupational and Other Health Insurance Companies was adopted, which introduced a competitive environment in the sphere of health insurance. The adoption of deficient legislation initially resulted in a rapid increase in the number of health insurance companies to as many as 27 in 1992. Due to the lack of state regulation and control, however, these soon experienced major financial problems, resulting in bankruptcies and subse-

quent dissolution thereof or mergers with other, financially sounder companies. Over time, the number of functioning health insurance companies was reduced to the nine that are currently operating.

In the first 3 years of the existence of health insurance companies, the provided medical care was financed on the fee-for-service principle, which resulted in the hunt for points and a major waste of financial resources. In 1997, health insurance companies began to apply per capita payments for each registered patient to care provided by general practitioners for children, adolescents, and adults, as well as advance payments derived from the previous period in the sphere of inpatient care. The fee-for-service (regulated) system was maintained only for outpatient specialists.

### 3.2 The role and status of the General Health Insurance Company

A milestone in healthcare funding was the decision to introduce a general health insurance system, later renamed public health insurance. At the same time, the General Health Insurance Company (VZP) of the Czech Republic was established. For 1992, as the first year of VZP's operation, funds in the amount of approximately CZK 40 billion were secured from the state budget. Furthermore, the Act on General Health Insurance stipulated that the activities in this sphere could be performed by the VZP and departmental, professional, occupational and other insurance companies, as applicable.

In 1992, VZP organised the reimbursement of healthcare for all citizens of the Czech Republic. As a result of the establishment of other health insurance companies, the number of VZP clients kept dropping; yet even in 2009 it covered the healthcare needs of more than 60% of the insured in the Czech Republic. As stipulated by law, VZP, in addition to its operation as a health insurance company, maintains a Central Registry of Insured, a Capitation Registry (records on patient registration with general practitioners), a list of contracted healthcare facilities, and a Health Insurance Information Centre (an overview of healthcare professionals delivering healthcare covered by health insurance in individual healthcare facilities). VZP also safeguards the administration of code lists, data interfaces, and methodology for public health insurance system documentation handovers.

## 4 A high-level description of the Electronic Health Book

The Electronic Health Book system represents a secure environment connecting healthcare providers, patients, and the General Health Insurance Company—it is a highly

secure online summary of a patient's medical information. The service greatly enhances the quality of patient care proper, and, moreover, increases the effectiveness of the provided care and brings savings to the entire healthcare provision process.

EHB won much recognition from the European Commission. In 2006, the Fourth European Government Conference on eHealth held in Malaga, Spain decided which projects in the sphere of information technology utilisation in healthcare would be recommended to the European Commission for broader application in the EU Member States. The eHealth Impact Study, which evaluated ten selected healthcare IT products in total, was prepared for the European Commission by the international research institute Empirica. According to this study, EHB is, in the long term, highly profitable, as it involves an extensive system which includes practically all groups of doctors, from general practitioners and specialists to hospitals, as well as pharmacies and patients [4]. The principles, upon which the EHB had been built, were recommended by Empirica for application throughout the European Union [1].

The Electronic Health Book may be presented as the patient's "GPS on their healthcare journey". It not only shows the patients where they are—an analogy of their current status of health—but also "which way to go and what to expect on the journey", i.e., what may be offered to them in terms of care for their health.

*"I view the Electronic Health Book system as a fundamental improvement of care, because, being the doctor, I will know everything about the patient. If, for example, a rescue paramedic who finds a person lying unconscious on the road has the opportunity to view the person's Electronic Health Book, to find out about his blood type, illnesses, and to estimate the likely current condition, he may save the person's life. Moreover, the system will result in significant savings of financial resources. From the practical experience of my fellow doctors, I know that some patients have one doctor prescribe a medicine for them and then they visit another doctor to have another medicine prescribed... The doctor cannot find out what his colleagues have already prescribed to the patient,"* says Professor Jan Pirk, M.D., head doctor of the Clinic of Cardiovascular Surgery and Cardiocentre of the Institute of Clinical and Experimental Medicine (IKEM) in Prague, Czech Republic.

#### 4.1 Data standard and structure

The Electronic Health Book uses the Czech data standard DASTA 2, 3, 4, allowing for a structured communication among the outpatient and hospital information systems.

From the medical point of view, the Electronic Health Book is divided into the following sections:

- Basic information (emergency and contact details)
- Records made by the client
- Medical histories
- Diagnoses
- Medications
- Hospitalisations
- Ambulatory examinations
- Laboratory tests
- Immunisation

#### 4.2 The Electronic Health Book vision

- Complete sharing of all health information resulting in improved healthcare.
- Engagement of all features of the system and supplementary services for health promotion.
- Provision of a "business-intelligence"-like model—background materials for better decision-making on the part of the doctor. The system will be a unique tool for science and research. Thanks to the anonymised "data mining", it will be possible to identify unheralded relations among diagnoses, treatments, medicines, consequences, and other medically followed-up aspects.
- Utilisation of anonymised data and their relationships for the further education of doctors.

#### 4.3 The Electronic Health Book mission

- To change the patient-doctor relationship towards their balanced share in healthcare delivery.

#### 4.4 Primary objectives of the Electronic Health Book system

- To improve the quality of delivered healthcare
- To provide the doctor with valid medical data
- To empower the citizen-patient ("patient-centric")
- To utilise (1) human resources (first and foremost) and (2) financial resources in an efficient manner

The principle behind the Electronic Health Book lies in effective sharing of the most up-to-date information about the health condition of patients among those healthcare professionals permitted by the patients to do so. Practical treatment works similarly. The advantage of the Electronic Health Book is that the medical history of the patient will always be available to the doctor at the right time, and the doctor will, with the patient's permission, add current medical records to it. An advantage like this can save lives and greatly enhance the quality of the healthcare provided.

The Electronic Health Book is based upon five pillars of the patient's health:

1. Data for rescue service—the Emergency dataset

Essential, life-saving patient health data may be made available to the medical rescue service in the event of an emergency. The attending doctor will thus have basic information about the patient, such as their blood type, last tetanus vaccination, risk factors, allergies and long-term medications, histories, hospitalisations, and personal details, in time.

2. Health records in one's own hands

The Electronic Health Book serves the purposes of online entries as well as viewing, i.e., sharing, health information between the patient and the doctor and among doctors themselves in real time. It is available via the internet, from any location, 24 h a day. The stored data are subject to high security. With EHB, the patient has an overview of all tests and examinations, the results thereof, and treatment. The patients become the owners of their health records which they may, if necessary, provide to their attending doctors who can more quickly and in higher quality make a diagnosis, start targeted treatment, and avoid burdening the patient with an unsuitable combination of medicines or repeated tests and examinations.

3. An insured's personal account

Such account contains overviews of reported healthcare, paid regulatory fees and extras for medicines, and allows the history of insurance and insurance premium payments to be checked. Thus, patients are informed about the cost of their treatment. The report also highlights overdue premiums where applicable.

4. Health manager

The Electronic Health Book alerts both doctors and patients to preventive activities and informs them of health risks. Features such as a preventive check-up schedule, an immunisation schedule, SMS/e-mail alerts, BMI index, blood pressure, and blood sugar measuring are available.

5. European interoperability

The fifth pillar of the EHB symbolises the European dimension of healthcare electronisation. The EHB system is part of the European Commission's epSOS project, which will establish service infrastructure to safeguard cross-border interoperability of individual Electronic Health Book systems in Europe without any need for amendment of the effective law and national systems [5]. As early as from the beginning of 2011, patients from 10 EU Member States travelling to other countries involved in the epSOS project will enjoy access to their medical records in a format that is clear also for the local healthcare professionals.

## 5 EHB features

The Electronic Health Book offers its users a number of features that present practical assistance during care for their health.

Essential health data are contained in the so-called **Emergency Dataset** (ED), which is completed by the general practitioner of the patient/user. The ED contains the patient's important health data which is necessary to save his life and which, in an emergency, may also be viewed by the medical rescue service. Essential information about the patient, such as the blood type, last tetanus vaccination, risk factors, allergies, and permanent medications are thus available to the attending doctor in time.

Following a patient's visit, the doctor sends the general medical history and current diagnosis and medication or, where applicable, performed or planned vaccination/revaccination to the patient's EHB. Moreover, individual outpatient and laboratory tests and examinations and hospitalisations in healthcare facilities are also recorded in the EHB. Users/patients have space available to them in the "**Client's records**" section to make their own entries on their subjective feelings or problems.

In a certain section of the application called "**Insured's personal account**", EHB users may check the history of their insurance and premium payments. Clients may request an overview of reported healthcare for the last 6 months to be sent to them; this overview contains records of individual procedures (medical examinations, laboratory tests, etc.), the site where they were done, and the amount paid for them by the health insurance company, as well as an overview of paid regulatory fees and extras for medicines. Thus, patients are informed about the costs incurred by their treatment. The overview also identifies overdue premiums, where applicable.

In the "**Profile setup**" section, it is possible to change basic data, such as permanent address or contact details. It is also possible to change the person who should be contacted in emergencies. The dataset also provides information on who the patient's general practitioner is. The scope in which the EHB may be viewed may also be changed; clients will decide whether their medical records may be viewed by all involved healthcare professionals or by confidential healthcare professionals only.

It is also possible to request a partial removal of a medical record; this, however, may be done only for an EHB record which does not contain clinical information. This section, moreover, provides the option to change the identity of the confidential healthcare professional.

In the "**Personal data**" section of the EHB, clients may amend their height and weight, set up their blood type, record their allergies and chronic diagnoses, or establish

their “WHR index”. The value of the index indicates the risk of health complications.

In the “**Body values**” section, clients can record the values of their blood pressure and sugar levels. These data may be also transferred to summary charts over time and measured values may be monitored for their compliance with recommended ranges. Information on their current height and weight may be entered by the clients themselves; BMI should then be assessed by the client’s general practitioner.

Prevention forms an integral part of the care for one’s health and preventive check-ups are the essence of preventive medical care. The users of the Electronic Health Book will therefore appreciate the option to plan events, of which they are alerted by the system, which sends a message to their mobile phone or e-mail in straightforward schedules. These include also the “**Preventive Check-up Schedule**” and “**Immunisation Schedule**” containing a detailed guide, which makes the planning of upcoming vaccinations easier.

The “Immunisation Schedule” application displays both completed and scheduled vaccinations and follow-up revaccinations.

The Immunisation Schedule in the Electronic Health Book thus allows for the monitoring of upcoming vaccinations and viewing of previously performed vaccinations. The so-called “Guide to Immunisation” is available to assist with navigation in the Immunisation Schedule. This guide will facilitate convenient entries of new vaccinations and their inclusion in the Immunisation Schedule.

Vaccinations may be entered in the Immunisation Schedule both by the client (i.e. the owner of the Electronic Health Book) and by the attending doctor. The attending doctor, however, may access the client’s Immunisation Schedule only if the client sets this option up for the doctor in his profile in EHB.

The Preventive Check-up Schedule is a complex tool which, on the basis of age and selected type, enables clients to determine recommended preventive check-ups fully covered for the clients by VZP, to retrieve information on the scope of the check-up, and to establish the minimum interval for the repetition of the procedure. Essential preventive check-ups include a preventive examination with the general practitioner, with the dentist, and with the obstetrician. The most important preventive examinations include a preventive ECG and preventive testing for cholesterol, glycaemia or occult bleeding.

The Preventive Check-up Schedule is quite straightforward. For example, before the last-entered preventive check-up of a certain type, the user is alerted of the necessity to re-enter this type of preventive check-up. Also, if the user amends any future event, all future alerts associated with this event will be recalculated.

In order to make the system user-friendly and in the interest of better-quality healthcare, the EHB offers the client certain useful tools. Through the medicines database, the client may access information from package leaflets of available medicines. The provided description of values serves as an explanation of laboratory results. The pharmacy database facilitates orientation in the location where the patient wishes to collect his medicines.

## 6 Utilisation for target groups

The Electronic Health Book is important particularly for the patient, the healthcare facility, VZP, and the medical rescue service.

### 6.1 Emergency dataset for rescue service

Patients have the opportunity to have their health records gathered in one place for their own as well as the attending doctors’ needs, without any degree of risk of loss or abuse as is the case with hard-copy records. Health records are available at any time from any location (even from abroad) to any doctor whom the patient authorises to view the Electronic Health Book (a one-off viewing of the emergency critical dataset is also allowed for the rescue service even if the patient has not authorised it to do so. In these cases, only the so-called “emergency dataset”, a set of vital information, may be viewed). This advantage may also be applied when changing doctors or when winding up a doctor’s practice, where the patient normally has to apply for hard-copy statements from their health records, which is often difficult for reasons such as disputes with the doctor or storage of the documentation with the regional authority, etc.

### 6.2 Patient involvement

Patients may themselves make records and comments in the patient section in order to use the system for their own health management (prevention; healthcare planning; procurement of information; and searches for doctors, healthcare facilities, pharmacies, database of medicines, and laboratory values); to effectively control the cost of the healthcare provided (personal account control) without having to visit a VZP branch or the post office; and to follow up on potential overpayments and unpaid premiums, so as to avoid (where the patient is the payer of insurance premiums) the risk of being penalised and having to pay fines for reporting failures or late or incorrect health insurance payments. The insurance company enters data available to it (medicines dispensed in pharmacies) in the Electronic Health Book in the form of a summary report, which may be used for healthcare manage-

ment regardless of whether or not the prescribing doctor is involved in EHB.

### 6.3 Benefits for healthcare professionals

The healthcare professional is provided with the information necessary for the continuity and coordination of care for the patient. By means of his outpatient information system for the maintenance of all medical records, the doctor sends information to the Electronic Health Book very easily and quickly. This concerns normal and enhanced local applications owned by the doctor, integrated with the Electronic Health Book. Outpatient information systems usually have an inbuilt communication interface, which allows for both the sending of messages to the system by pressing a key as well as for the retrieval of information from the system for the doctor's needs.

In the future, the Electronic Health Book will also serve healthcare facilities as another way of handing over healthcare billing data. This will bring the healthcare facility the benefit of labour savings (nowadays, healthcare facilities have to prepare batches for the insurance company separately) and of establishing a correlation between the record in the documentation and the invoiced care (reduced risk of revisions, incorrect or insufficient reporting, reporting speed—the possibility of conversion to online reporting, which will be introduced by the insurance company in 2012).

### 6.4 Benefits of the EHB system for individual elements in healthcare

#### 1. THE PATIENT

- Has an overview of test results and treatment
- May actively take care of his own health through the use of the Immunisation Schedule or by monitoring his BMI index, for example Communicates better with the doctor
- Avoids unnecessary repetition of some tests and examinations
- Has his information in the Electronic Health Book secured from abuse

#### 2. THE DOCTOR

- Is alerted by the system that his patient's test results have already been entered into the system
- May retrieve the tests and examinations completed for the patient
- Is provided with up-to-date and accurate information on the status of health of his patient
- Has the information in time and during the patient's visit to his office

- Will save time because he does not have to carry out duplicate or redundant examinations or prescribe medicines which have been prescribed by another doctor

#### 3. THE INSURANCE COMPANY

- Allocates resources where they are needed most, i.e., to patient treatment
- Achieves higher effectiveness in the way individual healthcare procedures are conducted

#### 4. THE HEALTHCARE SYSTEM

- Improved quality and pace of delivered healthcare is achieved
- Uncoordinated prescription of medicines is avoided
- Significant savings are achieved in the public health insurance system
- The EHB system supports utilisation of information technologies in healthcare
- Sensitive health information is protected from loss or abuse in the EHB system better than in the filing systems in doctors' offices

### 6.5 Stabilisation of VZP revenue

It is assumed that clients for whom the Electronic Health Book represents an added value will be less motivated to change their health insurance company (to leave VZP), which is important for maintaining the insurance company's revenue. A client that has ready access to information on the care provided to him as reported by healthcare facilities may easily alert the insurance company of procedures which have not been performed and medicines which have not been provided, allowing the insurance company to conduct targeted revisions and to refuse reimbursement of such procedures.

Doctors' awareness of this option alone has a preventative effect. Doctors involved in the system may coordinate their care with other healthcare facilities, which makes it possible to reduce the costs of healthcare by avoiding those procedures which would be duplicated (repeated laboratory and other tests and examinations performed by various healthcare facilities in the situation where doctors from these facilities do not know that these tests and examinations have been completed, or where, despite having this information, they do not know the results thereof).

The situation with the prescription of medicines is similar: it is not unusual for a patient to have the same medicine prescribed by several doctors, with VZP having no way to penalise the doctor or the patient (the doctor has provided an indicated medical prescription, and the patient is not responsible for what the doctor has prescribed). Last

but not least, due to its exclusiveness and patent protection, the Electronic Health Book is a major competitive advantage for VZP compared to other health insurance companies.

#### 6.6 The Electronic Health Book as the cornerstone of eHealth in the Czech Republic

To date, the Electronic Health Book system is the only feature of eHealth implemented in the Czech Republic on the national level. Healthcare electrification is an essential prerequisite for increasing the effectiveness of processes across the healthcare system. As the cornerstone of the future eHealth system in the Czech Republic (be it established uniformly and universally through the role of the state or pluralistically in the competitive environment of health insurance companies and other entities operating in healthcare), the Electronic Health Book gradually generates the infrastructure and experience necessary for eHealth. It represents the option and motivation for doctors (as well as patients) to become involved in electronic communication, to obtain a computer, and to maintain electronic medical records. It creates the potential for future development in the sphere of electronic prescription of medicines and the application of electronic identifiers of healthcare professionals and the insured, with the possibility to authorise the delivered care online.

### 7 Methods of registration in the system

Registration of the Electronic Health Book can be done in several ways. One of the options is to register directly at a registered doctor or at a contracted partner authorised to perform registration (a pharmacy network, a branch of Czech Post equipped with the Czech POINT service data stations—public administration contact points fulfilling certain e-government services, or directly at VZP branches).

The quickest way is online registration directly at the website of IZIP ([www.izip.cz](http://www.izip.cz)) or completion of a hard-copy application, in person or with the help of any of the field staff. Following registration, the client will obtain a registered personal mail delivery containing his client data (client identifier), client access password, and client communication number. Doctors register in the system mostly via regional IZIP representatives.

#### 7.1 Voluntary-consent-based patient registration into the system and personal EHB administration

Registrations into EHB are based upon a voluntary decision of the users/patients as well as doctors. IZIP is listed with the Office for Personal Data Protection of the Czech

Republic. Registration is done in compliance with the law and based upon the patient's consent—these are the two key elements that distinguish the EHB system from other systems in the world.

When registering, the patients complete, in addition to their personal and contact details, the health insurance company code and their confidential healthcare professional. At the same time, during the registration, the patients have the opportunity to decide whether they wish to give their permission to view their Electronic Health Book to all healthcare professionals registered in the EHB system or not. Furthermore, the patients express either their consent with providing selected data from the EHB to the attending doctor within the EU for the purposes of provision of care should healthcare be delivered in any of the EU Member States, or refusal thereof.

Once the EHB has been activated, the clients may extend or restrict the number of doctors who may view the data from their EHB. This concerns a set of so-called “confidential healthcare professionals” who are authorised to view the patient's EHB. It is also possible for the patient to change the contact details and the person who should be informed in case of an emergency. The dataset also provides information on who the patient's current general practitioner is. Authentication passwords for EHB may be also amended.

It is possible to set up the method of logging into EHB—either by the identification number and personal password or by the identification number, personal password, and an SMS password or certificate.

The EHB may be blocked, e.g., in case of suspected abuse. In such case, new authentication details without which it is impossible to enter the EHB are sent to the client's address; records made by healthcare professionals and facilities, however, may still be sent to the blocked EHB.

Using their current authentication details, the clients may switch off their EHB, i.e., temporarily suspend the functionality of the EHB and all related services. Once the EHB has been switched off, it is no longer possible to send records thereto. Switching the EHB on again can be done easily by re-entering the authentication details.

To cancel an EHB, the client completes a request including immediate, irreversible and complete deletion of all personal data contained in his Electronic Health Book. Such EHB is permanently cancelled.

The client may also be represented in EHB by his guardian (e.g., by one of his parents) or by a trustworthy individual (for example, seniors who wish to inform their family members about the status of their health may make use of this option).

Both the patient and the doctor use their own authentication (user name, password) to access the EHB, and any movement within the system is logged. The patient (owner of the EHB) may check these movements at any time. Any



operation conducted in the client's EHB, whether performed by the patient or any other stakeholder (healthcare professional), is audited.

## 7.2 Involving the doctor in the Electronic Health Book System

Registered doctors work in the system actively, i.e., they view Electronic Health Books and their software automatically makes records in the patients' Health Records, extending the information base for their fellow doctors.

Doctors are registered in the EHB system by an IZIP sales representative. Once the contract is signed and authentication details delivered, the doctors may begin to make records in/view the Electronic Health Books of their patients. The entering of medical records is motivated financially, subject to the pricelist quoted in the contract.

In addition to their ambulatory software, doctors use the free IZIVIEW, IZITool applications and direct access to the web interface for making records in or for viewing the Electronic Health Books. Both recording and viewing in the system is thus very easy and quick: information is sent off automatically, and the data structure is clear and straightforward for all doctors [7].

Within the EHB system, two access types exist:

*Making entries into EHB* In most cases (99%), an electronic interface for the receipt of medical reports is used for the purposes of making entries into the EHB system. Communication is conducted solely via a secured encrypted channel on the basis of user authentication. The EHB system avails of several types of communication gateways. For the receipt of medical reports (documents in the DASTA standard, version 2, 3, 4) these are:

- IZIGATE—a web service for the receipt of medical information authorised by a healthcare professional into the EHB system from the various AIS/NIS/LIS systems. This service has been created on the basis of synchronous web services and as such primarily serves for the receipt of health information (clinical data of the insured).
- EHB Gate—this is actually a significantly advanced IZIGATE with additional functions included, such as receipt of medical information, individual entity account administration, retrieval of current medical records (information which have not yet been viewed by any healthcare professional), obtaining information from the insurance company for a specifically queried entity, etc.

The EHB interface uses fully asynchronous communication between the client and the available services, where the communication is always initiated by the client (i.e., the consumer of the services). The interface has been built upon the standard of web services and WS-\* specifications.

The authentication into the EHB system uses a single sign-on, where the client, having successfully authenticated himself, receives a security token (an EHB Auth service), which is then added to any request as an identity check for the various services of the system (such as the EHB Gate). The validity of the token is limited in time.

The matching of “request”—“response” messages is conducted on the correlation id level. Once any message is sent via the EHB interface, the client will in reply receive an id allocated to this message. Thereafter, the client uses this id to check the receipt of responses within the scope of the so called databox.

These interfaces (API) are purely electronic and serve for the purposes of automatic communication among the NIS/AIS/LIS systems (hospital IS, ambulatory IS, laboratory IS).

In addition to the above-mentioned interfaces for electronic communication, it is also possible to use a web interface for the manual input of medical information about the insured.

*Viewing EHB records* This access has been designed primarily for the reading of medical records within the EHB system. For this purpose, every registered and verified healthcare professional is allowed to access the profile of the selected insured (client). The information provided is structured pursuant to a proposed consensus of the Ministry of Health of the Czech Republic and healthcare professionals, defined in the DASTA standard [9, 10].

The web interface, available both via a web browser and via the IZIVIEW tool, serves primarily for the purposes of accessing this information for viewing.

In certain cases, it is also possible to make use of an electronic service (part of the EHB Gate), which provides information in the DASTA standard. In this case, it involves a certain aggregated view of the data about the insured. Use of this channel, however, is strictly limited to medical rescue services and, as such, is subject to certain legislative provisions governing the protection of persons and property.

## 8 Standards used by EHB

As part of data exchange within the Czech Republic, the IZIP system uses the following:

1. The national standard issued by the Ministry of Health (DASTA) for the document sections (Czech Republic)
 

In its data blocks, DASTA refers to internal and external code lists, the number of which exceeds three hundred. The most important ones are the set of code

lists for the National Health Information System (NZIS) and the set of code lists for the laboratory complement, whose most significant part is the National Index of Laboratory Items (NČLP).

This standard has been used in everyday practice for more than 10 years and has been integrated to all existing significant health information systems in the Czech Republic. In respect of the patient data, DASTA allows for the transfer of information from many spheres, particularly the following:

- Patient identification data
  - Essential information on the patient (personal details, birth number, addresses, height, weight, etc.)
  - Emergency information (blood type, allergies, diagnoses)
  - Payment relations, insurance companies, sick leave
  - Medical history
  - Medications
  - Vaccinations
  - Permanent and current diagnoses
  - Clinical events of many types—scheduled appointments, results, reports (e.g. laboratory, radiodiagnostics, documentations of various types, special tests and examinations as per the index of clinical events, etc.)
  - Accounting and Management Information System (MIS) source materials—this is possible only from version 4 on
2. Code lists issued by the Ministry of Health of the Czech Republic, such as the National Index of Laboratory Items (NČLP). (MZČR2)

The National Index of Laboratory Items is currently the only standard for communication among information systems in the domain of laboratory fields with more than a ten-year history of application. It is, furthermore, interconnected with a data superstructure allowing for a qualitatively higher level of standardisation in laboratory medicine. The NČLP items have been constructed on the basis of IFCC international nomenclature, which defines the relevant terms. According to this nomenclature, “components” (such as analytes, entities) are tested in “systems” (sometimes, but not always identical with the term “biological material”), the “kind-of-property” with the “unit” are determined (where relevant), and examinations are conducted via “procedures” (the principle of component determination)—these five elements (i.e., the system, component, procedure, kind-of-property, and unit) define each item of the NČLP index.

Every item of the NČLP index is thus explicitly defined by the NČLP key, used by DASTA, but also by the LIS and NIS systems. The following is an example of the construction of a NČLP item: Glucose (P; substance conc. [mmol/l] abs. spectrophotometry) with the NČLP

key=12352. Glucose measured in plasma as substance concentration in the mmol/l units by absorption spectrophotometry (there are several defined methods or procedures)—the key 12352 is allocated to it.

3. International classification of diseases (ICD-10) for diagnoses (WHO) [13]
4. Anatomical Therapeutic Chemical (ATC) classification of pharmaceuticals for active substances contained in prescribed and dispensed medicinal products (WHOC) [15]
5. ISO for country and language codes (ISO 3166–1, ISO 639–1)

## 9 EHB data security and protection

The EHB data are secured against theft or abuse with available state-of-the-art tools. They may be viewed only by the patient and the doctor authorised by the patient to do so. The Electronic Health Book operates on the basis of similar principles as electronic banking. Its degree of security, therefore, cannot be compared to that of data in a regular filing cabinet in a doctor’s office.

IZIP, a. s., is the holder of a certificate of conformity for information security management granted to companies with quality data protection systems (international standard ISO/IEC 27000), and its system is listed with the Office for Personal Data Protection.

Following the registration into the EHB system, the client obtains primary login details to be used for the activation of his Electronic Health Book. These primary login data are the “client identification number” and “client access password”. Upon activation, the client selects his own “client personal password”.

Once the Electronic Health Book has been activated, the combination of the “client identification number” and the newly created “client personal password” is used for logging into the EHB. The “client access password” used for the activation is not used for the login to the client’s Electronic Health Book proper.

Once the client has set up the personal password, he has the option to enhance the security of access to his Electronic Health Book. For login purposes, the system allows for the use of a single-use SMS password sent to the client’s mobile phone. The login with the single-use SMS password complements the standard login with the identification number and client personal password.

Another separate method of login is login using an access certificate issued by any of the authorised certification services.

Data are not stored in a single centre, but on two servers of which each contains different types of data. Furthermore, the data are subjected to manifold security procedures.

All activities within the EHB are logged and may be traced back, allowing the EHB owner to check them.

Like any complex system, EHB is highly secured and is subjected to tight controls performed in several steps:

- a) Internal penetration testing
- b) Independent external penetration testing;
- c) By monitoring systems, both on network security level and application security level
- d) The monitoring systems automatically inform responsible persons about potential problems.

The EHB system has never been successfully broken into by any form of electronic attacks. For these purposes the system is protected and monitored both on the network level and on the application level. Individual requests that may be evaluated as potential hazard are logged and assessed both automatically and through a follow-up check. Within the scope of the EHB system, continuous testing (penetration testing), internal as well as external, takes place several times a year in order to safeguard maximum data security.

## 10 Interconnecting on the EU level

In a short time, electronic healthcare will surely contribute significantly to making vital, life-saving health information available as soon as possible at any location in Europe. This is an important part of cross-border movement of citizens and patients. It therefore represents a necessary dissemination of information, the importance of which grows together with the increasing movement of people travelling within the EU for both work and leisure.

### 10.1 The ePSOS project and the role of the Electronic Health Book

The importance and uniqueness of the Electronic Health Book is also supported by its involvement in the European project ePSOS, where it represents the Czech Republic. ePSOS is a large-scale European Commission pilot project which currently involves 10 European countries: the Czech Republic, Denmark, France, Italy, Germany, Austria, Greece, Slovakia, Spain and Sweden. The primary objective of the project is to create an interoperable environment for electronic cross-border exchange of healthcare information. This is the chief precondition for the pan-European implementation of eHealth (electronic healthcare).

As part of the ePSOS project, the EHB system has been integrated with the information systems of healthcare providers from the EU Member States via the National Contact Point (NCP). ePSOS is an extensive project of the European Commission involving, since July 2008, 10 EU Member States through their Ministries of Health, national

competence centres, and a number of various companies. The Czech Republic is represented by the IZIP company in the project.

The ePSOS project has determined two major ehealth services for which the interoperable solutions in cross-border communication are being developed—summarised electronic medical records (Patient Summary) and electronic medical prescriptions/dispensing of medicinal products on electronic medical prescription (ePrescription/eDispensation).

As electronic prescription is still not used in the Czech Republic, the EHB system within the EU currently supports only the exchange of the summarised electronic records, which include the following:

- Basic patient data (such as name, age, etc.)
- Medical history, incl. the most important clinical information about the patient (such as allergies, current medical problems, medical implants, extensive surgeries conducted in the last 6 months)
- Information on prescribed and used medicinal products
- Information on summarised electronic medical records (e.g. who and when created the summarised electronic medical records)

The summarised electronic medical records with patient data are provided to the doctors in their respective languages. The language barrier, which often arises in situations when patients seek medical assistance abroad, is thus eliminated. The summarised electronic medical records provide doctors in emergencies as well as in routine situations with important information which facilitate the doctor's decision-making, thus helping to safeguard quality and safe healthcare (preventing e.g., potential drug interactions).

The standards used in ePSOS are as follows:

1. The structure of the documents uses HL7 CDA and for PatientSummary it is based upon:
  - a. Continuity of Care Record (ASTM standard) (ASTM) [2]
  - b. IHE Patient Care Coordination (PCC)
2. The following code lists are used as part of the PatientSummary:
  - a. LOINC for document sections (LOINC) [8]
  - b. Anatomical Therapeutic Chemical (ATC) classification of pharmaceuticals for active substances contained in prescribed and dispensed medicines (WHOCC2) [16]
  - c. International classification of diseases (ICD-10) for diagnoses (WHO2) [14]
  - d. EDQM standard for pharmaceutical forms and routes of administration (EDQM) [3]
  - e. UCUM (The Unified Code for Units of Measure) for units (UCUM) [11]

- f. ISO for country and language codes (ISO 3166–1, ISO 639–1)
- g. ISCO for classification of occupations (ILO) [6]
- h. SNOMED CT for: allergens, blood groups, interventions, implanted devices, vaccinations
- i. HL7 codes and IHE codes for technical and organisational information, such as the document confidentiality level, contact person's kinship, etc.

This project, however, has no development ambitions. Its primary objective is not to develop a new solution for healthcare data administration and to “force” it upon the Member States. Its role is integration. This means that the project strives to utilise the existing solutions used in the Member States as much as possible and to “teach” them how to communicate with each other. The European Commission has decided to include the project within the scope of its strategic Competitiveness and Innovation Programme (CIP) among those activities which will be partially financially supported and promoted by the Commission.

In the Czech Republic, the epSOS project will involve patients—EHB users who will give their explicit consent to the handover of data from the Electronic Health Book to those EU Member States where healthcare is provided to the client. For those clients who give their consent, a so-called summary patient medical record will be created, the structure of which has been established by the project's working group. If the patient—EHB user is provided with healthcare during his temporary stay in any of the EU Member States participating in the project, and the attending doctor asks for this summary patient medical record, this record will be delivered to the doctor via contact points. The handover of the summary patient medical record shall be conducted solely for the purposes of healthcare provision. No other use of the data is allowed. Both system and legislative protections are applied here.

## 11 Statistics and surveys

At the beginning of 2010, a leading company conducting surveys in the Czech Republic, Ipsos Tabor, conducted a survey of the Czech public. In a sample of 1,000 respondents Ipsos Tabor established the potential of the Electronic Health Book and analysed its major strengths and weaknesses. The results of the research suggest that the situation on the market is very favourable for further dissemination and application of the Electronic Health Book.

The public opinion on the contribution of the Electronic Health Book to enhancing the quality of healthcare is definitely positive, with 46% of respondents thinking that the Electronic Health Book will definitely/likely contribute

to increasing the quality of care. The degree of positive evaluation decreases with less knowledge and non-utilisation of the system. The major benefits are particularly the centralisation of information and speed. Availability, the patient having a good idea of the status of their health, and better quality of doctors' work were also often mentioned.

As many as 86% of respondents consider the possibility for the doctors to obtain information on their health condition in life-threatening situations to be clearly the most important function of the system. Other important functions are the possibilities to have complete medical information stored in one place and immunisation alerts. Most respondents also consider the other functions of the EHB to be important. The degree of interest in the system is high: 83% of the EHB non-users have shown interest in getting the service. A higher degree of interest was established particularly among those people who are at least aware of the Electronic Health Book. People with higher education are slightly more motivated to get the service. The major reason for interest in the Electronic Health Book is the option of getting an overview of the status of their health and easy access to information/the option to have the information in one place. One-fifth of respondents also mentioned easier communication between the patient and the doctor and among doctors themselves.

## 12 Final status vision—eHealth in the Czech Republic

The future development of the Electronic Health Book is closely related to the development of eHealth in the EU and thus in the Czech Republic as well. Currently, a National eHealth Development Plan for the Czech Republic is in place. Its purpose is to establish a politically acceptable base for a coherent national eHealth strategy development in the Czech Republic. The plan is based upon the current situation in the sphere of eHealth in the Czech Republic, in the European Union, and globally; available information on development plans for various areas; and the Czech government's declaration.

The purpose of all of the measures is to contribute to the better health of citizens, to make the provision of healthcare to both Czech and EU citizens more effective, and, thus, to increase the quality of this care and patient safety. The implementation of information and communication technologies will establish conditions for high-quality and efficient provision of healthcare, for involving the citizen in the healthcare process, and for effective utilisation of financial resources. The utmost priorities are high quality of healthcare, access to healthcare, and long-term stability of the system of health service delivery. All of the measures have been focused upon empowering the citizen/patient/insured within the healthcare system.

In the next 5 years, electronic scheduling of patient visits with doctors will become a standard. The benefits of electronic healthcare will become fully apparent in the sphere of prevention and in the treatment of chronically ill patients. As early as in the course of this decade, medical records in electronic format will begin to be utilised regularly in the healthcare systems of EU countries, and the billing of medical services to health insurance companies will be carried out online, with the patient's endorsement.

eHealth is understood to be an aggregate name for a number of tools based upon information and communication technologies which support and enhance:

- Prevention
- Diagnostics
- Treatment
- Health and lifestyle follow-up and management

The tool for implementing the initiative is the development, continuous updating, and implementation of the National Plan for eHealth Development in the Czech Republic. The key areas are as follows:

- National policy, legislation, and standards
- Electronic medical records
- Electronic identification of patients and healthcare professionals
- Healthcare information network
- Electronic education for citizens as well as healthcare professionals

The IZIP/Electronic Health Book project closely cooperates with the Czech National eHealth Forum.

### 13 Conclusion

We believe that it is in the highest interest of patients to have the opportunity to be cured as best and as quickly as possible, should they encounter any medical problems. And it is in the interest of doctors to have the opportunity to offer patients treatments that are as effective as possible. This, however, is not feasible without having the relevant information. Information has to be at the right place at the right time. At present it unfortunately does not work like this in the Czech Republic. Partial information on a patient's state of health is kept by individual doctors and the degree of sharing is minimal. The same may be said

about tests and examinations. EHB offers a simple solution where the necessary information is available to doctors practically immediately and, should the need arise, all over the world.

The EHB system is currently technologically fully functional. Its future lies particularly in the hands of doctors. The infrastructure and the number of involved entities is an indisputable advantage of the EHB project. The project is at present at a stage when it is necessary for the service operator, i.e., the General Health Insurance Company of the Czech Republic, to stir healthcare professionals into action, and for clients to use the EHB system to a much broader extent than before. The approach which will help to achieve this objective represents adequate combination of education and motivation based on contractual relations.

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