Deployment of Electronic Prescriptions in Belgium

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***Abstract*—After a two-year pilot, including the ICT (Information and Communication Technology) developments and small scale tests, the Recip-e project for ambulatory electronic prescriptions is currently in national roll-out phase. Along with the operational secure data-flow, an important number of parameters are captured and taken along; these parameters are processed and archived, enabling us to make a first evaluation regarding the approach taken in Belgium, both from a technical point of view and from a methodologic point of view, regarding the technical developments and the involvement of all stakeholders.**

Keywords: electronic prescription; e-health; deployment

I. INTRODUCTION

Prescriptions are a cornerstone in most health systems: in the paper world, the prescribing health worker (general practitioner, specialist, dentist) writes down a medical prescription on a pre-formatted piece of paper, signs it and usually hands it over to the patient. The patient then collects the medication, written on the paper prescription, in a pharmacy. Here, health systems may differ greatly: in some countries the choice of the pharmacy is not free (e.g., Denmark where this is determined at the time of prescribing, and often limited by physical constraints: islands with a single pharmacy [4]). In other countries, the choice of the pharmacy is free: the patient determines where he will collect the prescribed medication. This last case corresponds to the Belgian situation [13].

In this paper, we will highlight the main design features of the ambulatory electronic prescription system "Recip-e" [14] in the sections II and III, then in section IV (Results) the roll-out process is quantified and discussed in the Vth section.

II. MATERIALS AND METHODS

The objective set forward for the Recip-e project phase 0 was to realize an in depth study to identify the elements required to realize the theoretical model. This theoretical model resulted from a study performed in the context of the Belgian Ministry of Health and Social Affairs in 2002 [13].

The pilot study covered following topics:

- Evaluate the functional, technical and operational requirements for a realistic implementation
- Make a stakeholder analysis
- Benchmark equivalent projects abroad
- Study the financial implications
- Communication / Interaction with the stakeholders
- Propose a roll-out plan.

Figure 1 shows the current flows of the paper and electronic prescriptions in Belgium: from the prescribing physician via the patient to the pharmacy which he can choose freely.

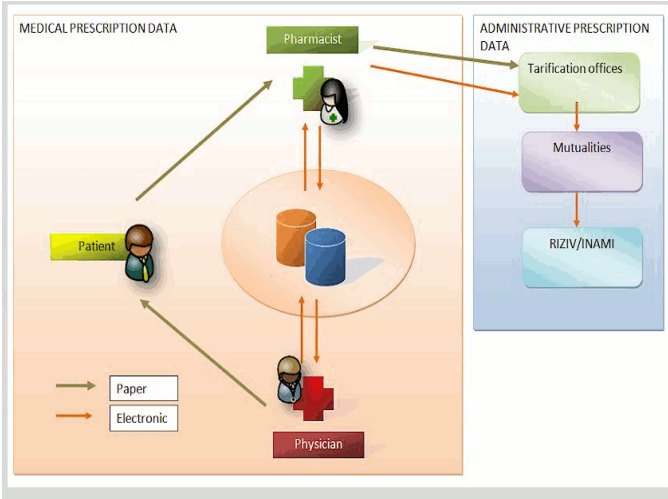

Figure 1. Recip-e dataflows

Benchmarking with Sweden and Denmark [1][7], teaches us that the introduction of EPP (Electronic Pharmaceutical Prescriptions) can take several years. Innovations in the medical sector are confronted with the relatively high inertia

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of the sector. This understanding leads to following eight border conditions for the technical solution of the "Electronic Medical Prescription" (EMP) in Belgium, where we need a system:

- Allowing perfect co-existence between paper and electronic prescriptions during the roll-out phase, which might take some time;
- At least allowing continuity in characteristics and identical functional possibilities versus the paper prescriptions;
- Requiring minimal legal modifications;
- Making use of open technology: standard protocols and platform independence;
- Keeping the medical information managed by physicians and pharmacists;
- Offering immediate benefits to all involved parties, right from the start;
- Identifying long-term benefits, resulting from full deployment;
- Putting emphasis on communication and dialog with the different entities and representative organisations of the health and social security sectors.

These eight points were identified at the start of the project. They obtained a consensus within the project team and were acknowledged by the sector representatives we consulted. Taking into account these border conditions, we designed the conceptual flow model, fitting into the Belgian health system, resulting in the flow diagram of Figure 1.

The flow of the electronic medical prescription starts at the prescribing physician (generated by the prescription module of his medical package) and goes to the EPP system. While in the first phase (during roll-out), the patient still obtains his printed-out paper prescription, complemented with an additional bar-coded number, the unique prescription ID, identifying the electronic prescription in the EPP database. This paper prescription now fulfills the role of a token, enabling the pharmacist or physiotherapist to retrieve the electronic prescription from the EPP system.

After the roll-out phase, paper tokens will become obsolete and identification at the pharmacy will be performed by the appropriate identification system selected by the sector in dialog with the authorities. From 2014 on, the pharmacists will be able to obtain the list of non-delivered prescriptions, recorded in the EPP database for a patient, by querying via the patients eID number. Unlike in the Netherlands [6], the Belgian eID number corresponds to the social security number.

III. TECHNOLOGY DESCRIPTION

A. Data Format

The building blocks required to realize an electronic prescription system are based on an existing technology :

1. Internet communication protocols/web-services
2. The Kind Messages for Electronic Health Records (KMEHR-bis) XML format for medical messages [8], including the medical prescription
3. Patient and medical worker identification by the appropriate electronic cards (eID or equivalent)
4. Advanced digital signature, via the eID resident signing certificate and recognised as equivalent to handwritten signature
5. Accessible and sound encryption technology
6. Adequate authentication portals, identifying the role of prescriber and pharmacist
7. Operational medication databases
8. Cheap and secure database storage

Emphasis here is on the role of the KMEHR-bis messages which play a central role in Belgium: since 2002, about 30 XML formatted messages were defined, they correspond to the most used messages in the Belgian health system. Through labeling sessions, enforcing the implementation of relevant KMEHR-bis messages, the Ministry of Health´s efforts and incentives resulted in the situation where all accredited software packages for general practitioners are now able to generate and read in the

KMEHR-bis messages such as the pharmaceutical prescription. The pharmaceutical packages don't reach this level of integration yet, but the experience with the "General Practitioners" (GP) packages shows that to obtain full compliance, no major effort will be required, moreover, just a single message plays a central role in the EPP system: the pharmaceutical prescription (KMEHR message 12d).

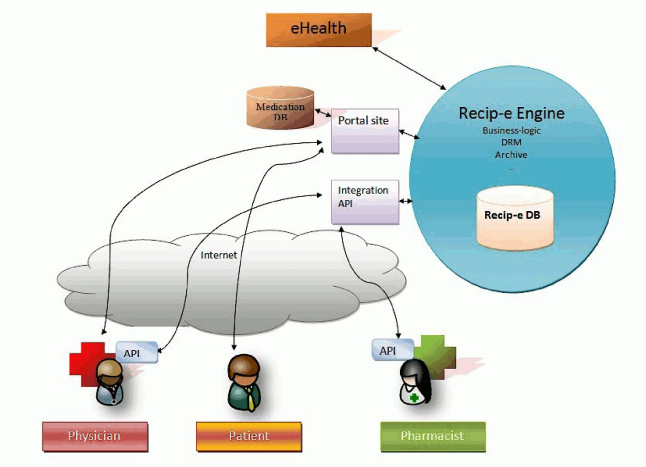

Figure 2. Recip-e components

The KMEHR-bis message "pharmaceutical prescription" comprises an administrative header, followed by a folder (containing the data which are found on a paper prescription) such as the prescriber´s identity, the patient and as many items elements as there are medications on the prescriptions.

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This number would be limited to 9, for practical reasons. The items comprise the market name of the medication, the unique Belgian identifier code for a given drug (CNK), the packaging and quantity, posology, way of administration, and the frequency (daily, morning/afternoon, ...) and free text instructions for patients.

Close examination of this XML message by experts in the field rose a single comment: the pharmacists would like to see the addition of the indication by the prescriber (the reason why this particular drug was prescribed), so that they can be involved in taking up responsibility for more appropriate use of the drug. This remark will be taken into account for the next version of the KMEHR messages and the prescribing physicians will be informed.

Tarification offices, of the pharmacists´ professional associations, health insurance and the social security administration are not part of the *inner loop* of the EPP project. They obtain the administrative and financial data regarding the delivered medication via the pharmacists, as is the case now (see Figure 1). Moreover, it would be desirable to include information regarding the insurance status of the patient and the permissions required for expensive medication (Chapter IV of the Belgian Nomenclature) as early as possible, preferably at the moment the prescription is made. To realize this, a connection with the MyCarenet service of the mutual insurance instances will be required. The MyCarenet services provide safe access to the insurance status of all individuals, registered in Belgium.

B. *Building Blocks*

Modules realized are (Figure 2):

1. The Recip-e portal allowing to define personal profiles by all users and adequate reporting and a prescription module, based, among others, on the "Belgisch Centrum voor Farmacotherapeutische Informatie" (BCFI-CBIP) [16] or other accredited medication database
2. The Recip-e Application Programming Interface (API): Recip-e is mainly be accessed through the API of the physicians or the pharmacists software package
3. The Recip-e engine contains modular building blocks, surrounding the secured prescription database
4. Links to authentic sources for authentication and identification of roles will be made through the eHealth-platform (national infrastructure supporting the generic building blocks).

Some building blocks needed by the Recip-e engine are provided by the eHealth-platform (time-stamping, logging, authentication, encryption, …) as for the whole e-health sector.

C. *Data flows and interactions*

Step 1: creation of a prescription by the prescriber. The prescriber creates an electronic prescription, normally via his medical package or via a web prescription program. The prescription is signed digitally (either each prescription is digitally signed or the prescriber´s session is authenticated via the e-ID + pin code of the prescriber, if a similar procedure can be accepted as in the intra-muros prescription). Then the prescription is transmitted in encrypted format to the Recip-e server. See Figure 2.

Here, some formal verifications are performed: identity of prescriber and patient´s identity. If all tests passed, a RID (Recip-e ID == unique identifier for each accepted prescription within the system) is attributed. The RID is sent in response to the prescribing system within seconds (max. 5s). The prescription is then printed, using the legal format, comprising the RID as a bar-code (Figure 3). Otherwise, a meaningful error message is generated and transmitted to the prescribing system.

For security reasons, the prescription is divided into several data-blocks:

- administrative (patient, RID)
- administrative prescriber (ID,..)
- medical: (medication, posology, ...)

blocks 2 and 3 are encrypted with a key, kept by the eHealth-platform, while encrypted data are stored in the Recip-e database.

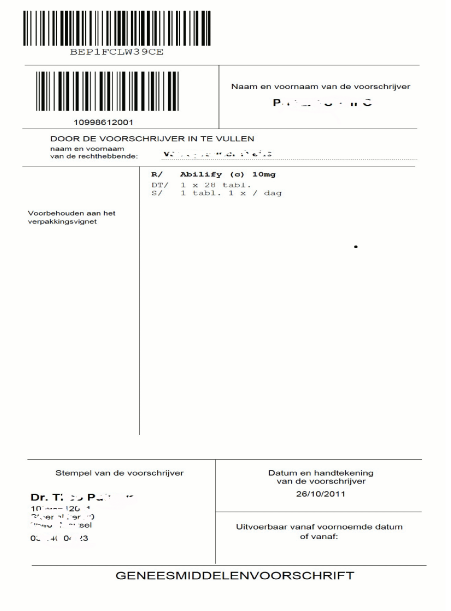

Figure 3. Paper "token" prescription with RID bar-code

The prescriber will automatically add the prescription to the medical patient record (outside the scope of Recip-e) and the patient obtains the printed-out prescription.

D. Technical implementation

During the pilot phase (2011-2013), three infrastructures were set-up:

1. The test-environment at the software developer Accenture (main software developer of the project)
2. The acceptance environment, integrated into the eHealth-platform's acceptance bus, servers and database hosted by Belgacom (the national telecom company and commercial datacenter provider)
3. The production environment, integrated into the eHealth-platform's production bus, servers and database hosted by Belgacom, managed by Recip-e.

These three were maintained throughout the pilot phase of the project and the current roll-out phase. Developments are first made and tested on the test server of the software developer, then transferred to acceptance and made available for testing purposes by software vendors of EMR's and pharmaceutical softwares and the Recip-e team. After approval, updates are then transferred from the "acceptance" to the "production" servers, accessible to the end-users.

In the roll-out phase, a fourth environment was set-up on independent servers, on another location (Uniweb), for the logging and monitoring functions, exclusively accessible to the Recip-e technical team.

Authentication of end-users, both in acceptance and in production environments is performed by a combination of the following elements:

- The national identity card and associated pin-code to authenticate the individual
- A certificate associated with the health worker and attributed via the eHealth-platform.

which result in "sessions". During such session, the health worker can access the system and perform the actions, associated with his role in the health system: a GP can create prescriptions, a pharmacist can deliver and a patient can consult the pending prescriptions, for himself as shown in Table 1.

TABLE 1. RECIP-E FUNCTIONS AND PERMISSIONS

Function	GP	Pharmacy	Patient
Create prescription	*		
Revoke (delete) prescription	*	*	*
List open prescriptions	*		*
Print prescription content	*	*	*
Mark as delivered		*	
Mark as undelivered		*	
Archive prescription		*	
Announce prescription	*		
Create feedback messages		*	
List feedback messages	*		

E. Management by the patient

The patient can manage (list, delete, forward) the prescriptions, related to himself, residing on the Recip-e server via a portal, that will be made available via the network of mutual insurance instances of the country and other health portals. He also can deny certain access rights for health care professionals to his pending prescriptions. Mandates should be managed outside Recip-e, but be part of a more general system, in which the e-Health platform plays a central role. Recip-e will make use of these generic services that will implement the operational access matrix of the complete health system. As long as this service is not yet operational, we will have to work with default values, corresponding to the procedures that exist in the current (paper based) health system, in complete accordance with legal and regulatory frameworks and in agreement with stipulations by the Privacy Commission [x] and the internal Recip-e ethical committee.

Step 2: The patient selects the care provider (pharmacist in case of pharmaceutical prescription) of his choice. He identifies himself by his electronic ID and (in the transition period, while paper prescriptions remain the only legally valid ones, he/she will then recover the pending prescription(s) via his professional package and will deliver what is written on the prescription). The electronic prescription is removed from the prescription server upon receipt by the care provider. The prescription system will not keep an archive of delivered prescriptions: this task remains with the care providers who have this responsibility right now in the paper world. We wanted to avoid a huge accumulation of sensitive medical data in a single place and by doing so, realize a link with another ongoing project by the pharmacies: establishing the medication records of individual patients, which already will include the original prescriptions (soon in electronic, time-stamped format).

IV. RESULTS

A. Deployment with the GP's

After the "pilot phase", national roll-out was prepared and effectively started in May 2013 by involving all recognized vendors of electronic medical records for general practitioners (17) and software for pharmacies (9), active in the country. Via the "registration procedure" managed by the Federal state's institution "eHealth-platform", vendors of GP software were required to implement access to the secure webservices of the health system and a number of applications, amongst which the electronic ambulatory prescriptions via Recip-e. Several mini-lab sessions and from the very start of the pilot until testing sessions were held to assist the software vendors and to assess the operation (end-to-end) via real-life scenarios. In September 2014, 14 of the 17 software packages for GP's complied and by November, all passed the tests.

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Progressive end-user deployment resulted in a consistent increase in the generation of electronic prescriptions as shown in Figure 4, taken on November 24th 2014; by mid-November 2014, we reached 19,000 prescriptions per day, by 1300 GP's.

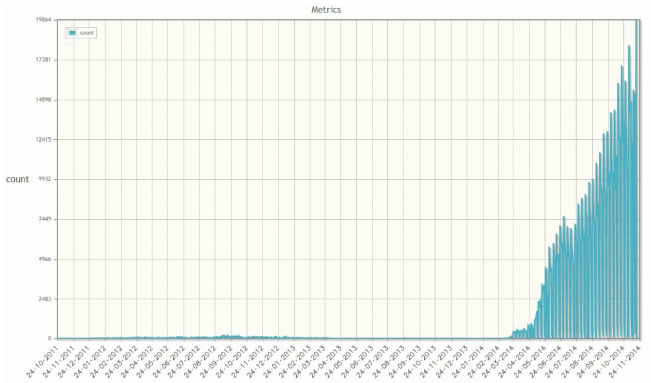

Figure 4. Daily produced e-prescriptions vs. time

We could also measure the rate of incoming prescriptions, vs. the time of the day, as shown in Figure 5. The most active part of the day is between 8:30 am. and 11:30 am., it is followed by a serious slow down between 12:00 and 16:00, then an active afternoon runs from 16:00 to about 20:00, be it at a slower pace than the morning period. These data should be taken into consideration to establish the required performance at full deployment.

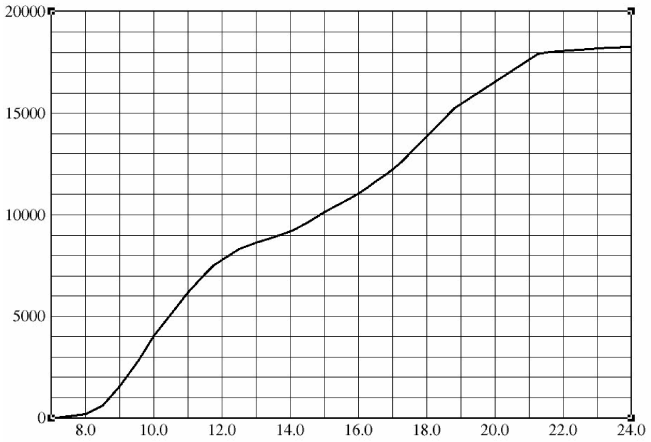

Figure 5. Incoming prescriptions vs. time of the day

It also shows that server maintenance activities and heavy scripts which require CPU power are best run between 2am and 5am when incoming prescriptions are very few in number.

B. Deployment at the pharmacies

The situation of the pharmaceutical software vendors differs, as for them, there is no accreditation procedure. Although this sector was encouraged and given explicit technical support, by September 2014, only 2 vendors (comprising 38% of the 5000 pharmacies) had implemented the Recip-e functions in their packages, but all 9 will be deployed in the first quarter of 2015. Whereas by mid-November 19,000 electronic prescriptions are generated, daily, only just over 1600 are delivered by pharmacies, leaving most indefinitely in our database! This is explained by the current geographical mis-match between GP's and pharmacies who are involved and by the on-going developments by the pharmaceutical software.

C. Informing stakeholders

A major effort was deployed to inform all stakeholders, including the end-users of the introduction of electronic prescriptions.

Software vendors were invited to participate in info sessions and mini-labs. Software demos were prepared, showing all the Recip-e functions in full-source, readily down-loadable and operational within hours in the "acceptance environment". A technical help-desk, ticketing system and interactive follow-up were established.

For the end-users seminars, conferences and demos were performed together with the respective professional associations (mostly GP's and pharmacists) and on-line materials are made available.

D. Deployment in other sectors of the health care system

Next to deployment of ambulatory pharmaceutical prescriptions by GP's, following targets are in the pipe-line:

- Prescriptions by specialists
- Prescriptions by dentists
- Ambulatory prescriptions from hospitals and clinics
- Physiotherapy prescriptions
- Nursing prescriptions
- Prescriptions by midwives

For each of these, the methodology, as followed for the pharmaceutical prescriptions by GP's is followed, be it at faster pace, because the same infrastructure and previous experience can readily be applied.

E. Remaining work

The paper-based prescription with additional RID-bar-code was intended as a transition tool between the paper prescription and the electronic one. In view of fully paperless operation, the approach of how and when de-materialisation will take place needs to be addressed in dialog with the stakeholders involved.

V. DISCUSSION

The deployment of the electronic prescriptions evolves consistently and although we have little leverage to force the end-users to start sending in electronic prescriptions, they

start moving in. Once prescribers have observed how little effort it takes, they continue to use the system.

For the benefits to become evident to the whole sector, we need to obtain a much higher deployment degree and familiarity of the end-users with the more sophisticated functions such as the feed-back messages and the verification of "list open prescriptions" enabling GP's to verify weather the patient has at least collected previously prescribed medication.

Pharmacists have the possibility to link the electronic prescription to their "robots", but the ergonomy of their softwares is a key factor.

Although in very few cases, inconsistencies between the paper-based and the electronic prescription were observed, due to software bugs and due to manipulation errors, in general, the roll-out strategy works.

VI. Conclusion and Future Work

The purpose of the Recip-e pilot study (phase 0) was to perform an in-depth analysis of all aspects of an electronic prescription system for Belgium corresponding to the theoretical model realized previously, fitting into the Belgian health system and aiming to obtain a consensus from all involved parties: physicians, pharmacists, authorities and the patients. The in-depth analysis resulted in pilot (phase 1) that enabled to implement and test on a small scale but with real data. This resulted in phase 2: the current national roll-out, which shows that in the transition, co-existence of paper-based and electronic prescriptions works, but that strong incentives are required to move the whole sector to make use of the electronic functions.

A very important element is the cooperation of all electronic service providers, to make the access by the end-users consistent, so that in a single step, they obtain a complete set of complementary services, combining administrative simplification, support to their medical information and communication in a secure way with guarantees of privacy and professional quality.

After completing the roll-out of the pharmaceutical prescriptions (or in parallel with the final steps), we will move to the remaining types of prescriptions and decide how and when full "de-materialisation" will take place, liberating us from the paper-based prescriptions.

Acknowledgment

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