An evaluation of e-prescribing at a national level

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Objective: The aim of the article is to describe the process of implementing the Estonian national second generation electronic prescription service (e-prescription) and determine if the objectives set by the Estonian government were fulfilled.

Materials and methods: The study presents an analysis of both retrospective and current data in the evaluation phase of a design research project. Sources include, among others, publicly available documents and previous evaluation studies.

Results: According to all of the major stakeholders, the Estonian e-prescription service has very high usability and user satisfaction scores have been high. There is only little empirical evidence available to confirm if the benefits aimed for in the creation of the service were achieved. From a public administration viewpoint, the implementation of e-prescription has led to potential efficiency gains.

Conclusion: The Estonian second-generation e-prescription system is widely used by citizens, healthcare providers and administrators alike. However, there are gaps in measuring the impact of the service, especially with respect to time savings and enhanced healthcare quality. Additional functionalities will be key drivers in creating benefits for all stakeholders. Future nationwide e-health services should have a more rigorous evaluation process carried out during the design and implementation stages.

Keywords Electronic prescription, health information exchange, impact assessment

INTRODUCTION

Properly implemented e-health services are expected to give citizens better access to higher quality health care, increase efficiencies for health systems and foster new business opportunities in Europe (1). Many countries in the European Union have made significant steps in developing local and regional health information networks (2). However, far fewer have succeeded in developing nationwide e-health services, for example, Sweden, Denmark, Netherlands and Estonia (3). Successful implementation in these countries has demanded joint efforts from a number of different stakeholders, making it a complex process. Therefore, the implementation experience of nationwide e-health services across different health systems in different countries can provide valuable information for governments that have yet to launch these services. Moreover, more context and technology descriptions in e-health research enable future comparisons between different systems and to draw causal inferences from outcomes (4–6).
The e-prescription service has been operational since 1 January 2010, allowing data exchange between patients, care providers, pharmacies and the Estonian Health Insurance Fund (EHIF). However, very little research has been done regarding the process and results of implementing the e-prescription. Previous research has shown that new technologies that transform health care systems need time to mature to allow evaluations of the outcomes (7). Therefore, this study is conducted 4 years after the e-prescription’s initial launch, enabling for trust and impact evidence to accumulate.

The article serves two purposes. The first goal is to outline and describe the relevant aspects in the process of implementing the e-prescription service. Second, the study aims to analyze whether the objectives of the e-prescription, as defined by the designers of the service, have been achieved.

**Electronic prescription service**

The electronic prescription service refers to any computerized system used to “enter, modify, review and output or communicate medication prescriptions” (4). Literature distinguishes between two generations of electronic prescription technologies. The first generation enables stakeholders to insert, alter and review information within a single information system and the second-generation technology allows independent parties to exchange information across different information systems (5).

Stand-alone technologies have been studied in both in- and outpatient settings with particular emphasis on reduction of medical errors, which is also a cost burden on health systems (8,9). However, evidence regarding these interventions has been varied: some has been modestly positive, some neutral (8–10) and some has even caused new potential errors and adverse effects (11,12). Results regarding time efficiency gains have also been mixed. Some reports indicate that physicians need more time to write electronic prescriptions compared to paper prescriptions (13), whereas others have found that the time to carry out medication management tasks do not depend on whether paper or electronic systems were used (14).

The impacts of second-generation electronic prescription technologies have been researched to a lesser extent. A review of recent literature found a lack of empirical data in assessing the impact of these technologies in primary care where the majority of identified benefits were only perceived (5). Other authors have also reported mainly positive attitudes and perceived benefits for electronic prescription services (15,16). Overall, our research has found a lack of data regarding the implementation of second-generation electronic prescription services as well as limited analysis of the impacts on different stakeholders.

**Estonian health care system**

Estonia is a country of 1.3 million people situated in the northeast of Europe. Liberal economic policies have been implemented since it became re-independent from the Soviet Union, Estonia has both low public debt and health care spending (17). Nowadays, e-Government services are widely accepted by both enterprises and individuals (18). Estonia has solidarity-based, mandatory health insurance covering 95% of the population. Health care is to a large extent financed through an earmarked tax on income, which is managed by a single public payer, the EHIF. Mainly public hospitals offer
secondary health services and general practitioners fulfill a gatekeeper role. All pharmaceuticals are distributed through either hospitals or retail pharmacies (17). Pharmacists are currently not legally recognized as health care professionals, which in the current context, means they have fewer rights to see patient medical information (19).

**MATERIALS AND METHODS**

This study presents the design process and evaluation of the e-prescription service through descriptive secondary data analysis. In the design process of a new information system, the evaluation should be based on the benefits it brings to society, given the particular environment in which it exists (20).

The basis of the evaluation is the utility the e-prescription provides based on the requirements set in the design process. The analysis serves to feed information regarding possible future improvements back into the system (21). The two main documents that have outlined the objectives in setting up the service are the Estonian Health Information System Development Plan 2005–2008 (22) and the E-prescription Project Plan (23)\(^1\). These documents are supported by information targeted to the Estonian general public, physicians as well as pharmacists (24–26).

The objectives set for the e-prescription service were divided into three categories depending on the type of benefit described. The independent goals of the service were related to improvements in time efficiency, cost efficiency or quality of care. The goals were in some cases consolidated when they refer to the same underlying effect such as “The patient doesn’t need to visit a doctor for a reissue of a prescription” and “time saved by patients”.

The data gathered originated from strategies, business plans, press articles, published studies, academic papers and annual reports. Moreover, the analysis included data reported directly by the EHIF and the Estonian E-Health Foundation (EEHF) through personal correspondence.

The literature search included both the academic as well as grey literature to identify prior studies on the e-prescription system in both Estonian and English. Estonian academic writings were searched for any theses or unpublished works on this topic. In addition, the authors identified studies on second-generation electronic prescription systems in other countries for comparison purposes. The search included Thomson Reuters Web of Science and Medline. Mendeley software (New York, NY) was used for data analysis. Finally, information was obtained from Estonian government organizations regarding the e-prescription service architecture and the impact of the service.

**RESULTS**

**E-prescription development process**

Estonia has been at the forefront of implementing public e-services to its citizens, ranging from basic e-registries to sophisticated services such as e-voting (27). Health care as a discipline has also been affected by the

\(^1\)These documents are not publicly available but have been provided by public authorities for the use of this analysis.
transformative power of information technology. The Estonian national e-Health infrastructure and services were developed in the course of 4 years from 2005 to 2008 (7,28,29). E-prescription was one of the aforementioned services designed to transfer data between health care providers, pharmacies and the EHIF.

The EHIF has a central position in the Estonian health care system as the single largest public payer of health services (18). As the purchasing is based on contractual relationships, effective data transmission is essential between the EHIF and its contractual partners (e.g. health providers and pharmacists). In 2001, the EHIF began centralizing their information systems through developing the capability to electronically transfer reimbursement claims and prescription data (30).

The EHIF began centralizing their information systems through developing the capability to electronically transfer reimbursement claims and prescription data (30). The electronic invoicing system developed by the EHIF can be seen as a precondition for the e-prescription service. As of October, 2002, all pharmacies were obliged by law to transmit the prescription information for reimbursement to the EHIF electronically using the electronic data transmission service called “TORU” (31,32). However, only reimbursable prescriptions were included in TORU. Information about non-reimbursable prescription medication was handled manually, without a reliable way of determining what proportion of paper prescriptions the patients did not pick up.

By the end of 2002, over 75% of health care providers and >50% of all pharmacies had signed data transmission contracts with the EHIF (32). In 2003, the EHIF started using the X-road framework for some data transmissions with its partners (33). The X-road is an internet-based secure data exchange platform provided by the Estonian government. It is the backbone for all public e-services, allowing data transmission among citizens, employers and government officials. Digital authentication is achieved via an ID-card, which can be also used to authorize data transmission between selected parties (34).

By 2005, all of the reimbursement claims and prescription data were submitted electronically to the EHIF (35). In order to encourage the use of public e-services among health care providers and pharmacists, data transmission using the ID-card was made compulsory from 2006 onwards. The change affected both health care providers transferring reimbursement claims, as well as pharmacies sending prescription data, for reimbursement to the EHIF (36). Furthermore, by 2005, the level of IT-usage in the Estonian health care system was quite diverse. Most care providers had already implemented different in-house IT systems without interoperability (37).

In 2005, the Estonian Ministry of Social Affairs was granted structural aid from the European Union funds to create a nationwide framework through four projects: the Electronic Health Record, the Digital Image, the Digital Registration and the e-Prescription (28). The services aimed to improve quality by enabling better access to and use of relevant health data, as well as enhanced health reporting and cost calculations (22). The EEHF was formed as an independent organization under the Estonian Ministry of Social Affairs. Its role was to become the central agent in charge of standardization and the development of digital medical documents. It brought together different stakeholders involving primary and secondary care organizations. The relevant legal foundations of the system were
established in 2007 by creating regulations for data protection during electronic transmission (28).

The e-prescription was one of the four new e-services, which aimed to enhance both the process, as well as the security of writing prescriptions (38). The service applied the pull model in which the physician sends the prescription to a central data repository where all pharmacies have access to it (5). Annex 1 presents a detailed overview of the service architecture. As a prerequisite for data transfer, a central database called the Estonian Medical Prescription Centre (PRC) was set up in 2007. The PRC included detailed information about the reimbursement rates for each pharmaceutical product, providing correct and complete information about the prescribed medication. The database was administered by the EHIF and connected directly to its accounting software (39).

During 2008 and 2009, the information systems of health care providers and pharmacies were advised to gradually integrate their information systems to the PRC. However, the associated costs were not reimbursed by the central government and therefore each party was able to choose between different IT service providers. By 2010, there were four different hospital information systems, four primary care information systems, as well as several ambulatory care software in use. Pharmacists were using three different local information systems (39). The EHIF also launched a Mini Information System Portal (MISP) for doctors and pharmacies to use in case they were not able to afford any of the commercial solutions on the market (31). In conclusion, up to 2010, all prescriptions were still paper-based but the TORU was used for communications between the government, health care providers and pharmacies.

The e-prescription service was activated on 1 January 2010, when pharmacies were obliged by law to start processing electronic prescriptions through the PRC. As many doctors were still writing paper prescriptions, TORU was kept active for the first year. The e-prescription service suffered from problems due to insufficient capacity to manage user requests during the first 6 months, leading to problems with processing and administering prescriptions. The physicians were requested to keep using paper prescriptions for the summer months of 2010 to relieve capacity problems (40,41). There were no further attempts to regulate the issuing of electronic prescriptions and after the problems were solved, physicians started to increasingly use the e-prescription service. Starting from the second half of 2011, the TORU was closed down and all communication concerning prescriptions was channeled through the PRC. As of January 2012, all of the non-reimbursable prescriptions were also digitalized (31).

The e-prescription service involved the integration of several state registries with different governance bodies. Coordination was carried out by the Ministry of Social Affairs, where subsidiaries such as the EHIF, the Health Board, the EEHF and the State Agency of Medicines needed to work together in sharing the data. Figure 1 illustrates the architecture of the e-prescription service. The PRC database is the backbone of the service, as it gathers and checks relevant data from different registries to:

- Identify the right to prescribe or dispense medication – National Registry of Health Professionals, National Registry of Health Services
Provision Licenses, National Registry of Pharmacists (registrar: The Health Board)
- Identify the right to be reimbursed for medication – Insurance database (registrar: the EHIF)
- Identify the pharmaceutical substance, the marketing license, the standard dosages and the rate of reimbursement – Coding Centre, Registry of Activity Licenses, Registry of Authorized Medicinal Products (registrar: The State Agency of Medicines) (42).

The e-prescription is an online service, making each created prescription simultaneously available and visible for physicians, pharmacists and patients alike. Health care providers have an overview of all the prescriptions that patients have been prescribed by health care providers. Moreover, physicians can see, if a prescription has been collected or not. The patient has access to the same kind of data through the government e-services web-portal (www.eesti.ee). Every pharmacist has access to the list of available and uncollected prescriptions for each person by entering their unique identity code into the system. However, the pharmacists cannot see any diagnoses related to the prescription or if the patient is taking any other medication. The service enables to set different controls for both the prescribers and the dispensers of medication. The e-prescription has had a long development path and has come to play an important role in the health care system of Estonia.

**Goals of the e-prescription service**
Two strategic documents of the Estonian Ministry of Social Affairs outlined the structure of the service, as well as expected benefits (22,23).
First, the e-prescription was expected to bring time savings for physicians, pharmacists and patients. Physicians were expected to spend less time reporting to the EHIF, as the monthly reports on issued paper prescriptions that each physician had to provide, would become unnecessary with the e-prescription service (22,23). Moreover, prior to the implementation of the e-prescription, the reimbursement rates (100%, 75% and 50%) had to be added manually on each paper prescription. Whenever an unfamiliar substance was prescribed, determining the appropriate reimbursement rate took additional time for the physician. As reimbursement rates changed throughout the years on pharmaceuticals, physicians needed to check the information from a separate database. The e-prescription added the up-to-date reimbursement rate automatically to the prescription. Time would also be saved by not having to provide duplicates for patients who had lost their paper prescriptions. Finally, potential time savings for physicians as well as pharmacists were expected due to removing the need for additional inquiries and clarifications as a result of illegibly written paper prescriptions (22). For pharmacists, the time savings were attributed to potentially faster processing times due to the e-prescription.

Second, patients were expected to benefit from a simplified process for repeat prescriptions of pharmaceutical substances consumed on a regular basis (e.g. patients with chronic diseases). Moreover, as it would be impossible to lose a digital prescription, patients would save time from not having to acquire a duplicate (22,23).

Third, the e-prescription system was expected to also provide cost savings for the EHIF, by improving the quality of reporting. Prior to the launch of the e-prescription, the error rate in reporting to the EHIF was estimated to be up to 2.44% of all prescriptions. Subsequent to the launch of the e-prescription, it was estimated to decrease to <1% (22). The errors physicians made in determining the reimbursement rate were corrected by the EHIF and the difference in costs was borne by the health care provider. Therefore, the e-prescription would eventually influence the costs of health care providers. The most tangible benefit for the state authority EHIF was expected to be the decrease in printing costs. Paper prescriptions were printed on a special custom made paper that was expensive. Before the introduction of the service, the EHIF printed 4.2 million paper prescription forms costing over 100,000 euros annually. With the e-prescription, the costs of paper would be minimal (22). The EHIF also expected cost reductions from improved efficiency in the internal work processes of reimbursing prescriptions.

Finally, the e-prescription service was predicted to enhance health care quality through better-informed physicians who were expected to prevent adverse drug events (ADEs) through being able to review patients’ complete medication histories (22). In addition, ADEs would also decrease, as the risk of pharmacists making mistakes due to illegible prescriptions would be minimized. Health care quality was also expected to benefit from a better overview of non-reimbursable medication, which prior to the e-prescription was only detected through a manual review of paper prescriptions. The benefits expected by the government had no specific time frame set nor were parameters set for measuring progress or cost savings.
Evaluation of the e-prescription service

In 2013, 96.9% of all prescriptions were fully digital and processed through the e-prescription service. The direct cost of implementing the service was almost 0.5 mEUR, including the set up costs, annual running costs for servers and maintenance. However, there were additional expenses for developing auxiliary registries, project management as well as system integration costs for pharmacists and health care service providers that were more difficult to determine (31).

The impact assessment comprised of three categories – time, cost and quality. Time savings were primarily viewed from an individual's viewpoint whereas cost savings was mainly related to the central administration of prescriptions by government agencies. The quality gains were projected to arise from less adverse drug events and better adherence to medications.

The first benefit category associated with the e-prescription was time savings for physicians, pharmacists and patients. A survey conducted in 2012 among primary care physicians (247 respondents) and pharmacists (187 respondents) supported perceived time savings. The respondents conceded that the time spent on prescribing depended on a range of both technical and content related factors such as the user interface of the local information system. The primary care physicians estimated that, in ideal circumstances, repeat prescriptions could only take up to 10–15 s. Moreover, a new prescription for a common pharmaceutical substance could take around half a minute (31). The process of writing and dispensing prescriptions has not been studied neither prior nor after the implementation of the e-prescription service. Therefore, no time-motion or observational studies can confirm the perceived effect. However, overall satisfaction with the e-prescription has been high among all physicians: in primary care (94% out of 212 respondents), in secondary care (93% out of 99 respondents) as well as among pharmacists (94% out of 148 respondents) (43).

There is little evidence available on the impact of the e-prescription system on patients. Patient level benefits were only realized if satisfaction rates with the service could be used as a proxy. Estonian Ministry of Social Affairs in cooperation with the EHIF published an annual public opinion poll that also included attitudes towards the e-prescription service. In 2012, 98% of people that had recently used the e-prescription service were either very satisfied or satisfied with the service (44).

The e-prescription service was expected to streamline the prescription process by improving the quality of reporting. The error rate was predicted to decrease to <1% of all prescriptions. Figure 2 shows that the erroneous paper prescriptions have steadily decreased since 2007. Overall, 10 638 730 prescriptions were issued in either paper or electronic form in 2012, of which 1006 were incorrect in some respect, representing an error rate of <0.01% of all prescriptions.

The paper prescriptions are still issued by some physicians and therefore the printing costs have not disappeared. The EHIF has been procuring paper prescription forms through framework agreements with suppliers. Each health care provider purchased the prescription forms from the EHIF when their supplies were depleted. Figure 3 shows that the amounts of paper prescription forms bought by health care providers started to decline after the
e-prescription was launched in 2010. Moreover, on the basis of existing data, the costs on paper forms have fallen 40 times so that in 2013 only 3% of the total cost of paper prescription forms remained when compared to 2009.

Figure 4 shows how the cost of purchasing paper prescription forms has decreased for the EHIF as well. The small number of forms bought in 2012 was due to the fast uptake of the service and the large number of paper forms left over from 2011. However, the trend associated with the costs is still markedly downwards.

There were no data available to make conclusions on whether the costs on information technology decreased due to the implementation of the e-prescription service. Although the process of reimbursing prescription

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2The data for 2013 include the number of prescription forms sold within January–October 2013.
costs became much less labor intensive, data on labor cost savings were also not easily calculated as public employees were reassigned to perform different tasks.

An important benefit of the e-prescription service was predicted to be enhanced health care quality through better-informed physicians. 67% of primary care physicians (out of 247 respondents) believed that they would make fewer mistakes, as they would be able to see all of the pharmaceuticals prescribed to a patient, with the e-prescription compared to writing a paper prescription (31). The perceived benefit could depend on which information system the primary care physician was using. There are several solutions available that differ as to the ease with which information is accessed. However, no studies have evaluated which different information systems better support physicians and pharmacists.

Table 1 summarizes the results of the impact of the e-prescription service. The table heading “Objectives” lists the main goals, prior to the implementation of the service. Evidence from both in Estonia and other countries is divided into perceived or demonstrated benefits (5).

Altogether, two studies were found that had measured the impact of the e-prescription. The first was a quantitative survey on perceived impacts for physicians and pharmacists (31) and the second was a quantitative study on patient satisfaction with health care services, one of which was the e-prescription (44). The central government’s internal information, referred as “EHIF data”, was valuable in determining if administrative cost savings were achieved. However, no studies were found on measuring if time savings occurred, and if so, how much time was saved. Also, no study was located regarding the impact on quality of care.

**DISCUSSION**

The e-prescription has become the most widespread e-health service in Estonia. During the first 9 months of 2013, almost 97% of all prescriptions in Estonia were electronically transmitted. As e-prescription is so widely used and user satisfaction among physicians, pharmacists and patients is high, the
Table 1. Objectives and results of the e-prescription service compared to previous studies.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Type of evidence</th>
<th>Evidence from previous studies</th>
<th>Evidence on the e-prescription service</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Time savings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1. Time saved by physicians</td>
<td>Perceived</td>
<td>+ (15,16,45)</td>
<td>+ (31)</td>
</tr>
<tr>
<td></td>
<td>Demonstrated</td>
<td>– (13,14)</td>
<td>No data available</td>
</tr>
<tr>
<td>1.2. Time saved by pharmacists</td>
<td>Perceived</td>
<td>+ (47)</td>
<td>+ (31)</td>
</tr>
<tr>
<td></td>
<td>Demonstrated</td>
<td>– (46,48)</td>
<td>No data available</td>
</tr>
<tr>
<td>1.3. Time saved by patients</td>
<td>Perceived</td>
<td>No data available</td>
<td>+/- (44)</td>
</tr>
<tr>
<td></td>
<td>Demonstrated</td>
<td>No data available</td>
<td></td>
</tr>
<tr>
<td>2. Cost savings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1. Decreased central administration costs</td>
<td>Perceived</td>
<td>No data available</td>
<td>+ Printing (EHIF data)</td>
</tr>
<tr>
<td></td>
<td>Demonstrated</td>
<td>No data available</td>
<td>+/- IT (EHIF data)</td>
</tr>
<tr>
<td>2.2. Decreased costs to health care providers</td>
<td>Perceived</td>
<td>No data available</td>
<td>+ Erroneous prescriptions (EHIF data)</td>
</tr>
<tr>
<td></td>
<td>Demonstrated</td>
<td>No data available</td>
<td></td>
</tr>
<tr>
<td>3. Better quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1. Less adverse drug events and/or medication errors</td>
<td>Perceived</td>
<td>+ (45,47,49)</td>
<td>+ (31)</td>
</tr>
<tr>
<td></td>
<td>Demonstrated</td>
<td></td>
<td>No data available</td>
</tr>
</tbody>
</table>

+ Evidence supporting the objective; – evidence not supporting the objective; +/- contradictory or inconclusive evidence.
service has paved the way for stakeholders in health care to realize the value in second-generation e-services. Still, the risk of failure in implementing large-scale health information exchange services is high, as they require investments, workflow changes and new skills (50). However, one of the positive side effects of the implementation of the e-prescription has been the ripple effect that has supported the development of other e-health services such as the national Electronic Health Record.

However, there were several obstacles during the implementation process that should be taken into account when designing future e-health services. Health care organizations and pharmacies were reluctant to invest additional resources in enabling the service. This could have been avoided by allocating more central resources to upgrade local information systems. Also, some physicians and pharmacists expressed negative views about the value of the service, raising concerns in the media (51,52). More efforts to increase public awareness of the e-prescription could have overcome those drawbacks. The fact that at the very beginning the service failed to cope with data transmission volumes shows the importance of thorough information technology capacity analysis before launching new e-services.

Previous research has drawn inconsistent conclusions regarding the various aspects of electronic prescribing such as time savings and quality of care improvements (5). Realizing the benefits is highly context-dependent (4,5) and highlights the need to define success factors in the case of each country and the implementation of each e-service. In Estonia, digital data transmission existed since early 2000s (30,32). In addition, the public data exchange infrastructure, the X-road, enabled the e-prescription service to achieve ease of use and to be implemented in a secure manner (34). The EHIF, as the main health service purchasing agent in Estonia and the multi-stakeholder EEHF, were both relevant actors in the implementation process. More specifically, it was possible for the former to tie the adoption of the service to financial incentives, motivating both physicians and pharmacists to invest in information systems. The EEHF gave health care providers more or less an equal role compared to the Ministry of Social Affairs and its subsidiaries, in the decision-making council. This, in turn, ensured that the decisions on standardization, financing and adoption of e-health services, including the e-prescription, were based on a broad consensus in the health system context. Aligning the goals of public health administration with those of individual stakeholders in health care ensured that the implemented change was managed on all organizational levels (53).

The e-prescription has, to a large extent, eliminated issuing incorrect prescriptions, which previously resulted in extra costs for health care providers. Moreover, the service has saved costs by vastly reducing the number of paper prescriptions forms. However, there is still relatively little empirical evidence concerning the e-prescription resulting in time savings and improvements in the quality of care, which were arguably two of the more important goals in designing the service. Several questionnaires have proven that physicians, pharmacists as well as patients are satisfied with the service (31,44), which could indicate a positive user experience from a service that supports or enhances work processes. However, the reasons influencing user satisfaction have not been researched. Furthermore, only a single
questionnaire was used in determining physicians’ perceptions of improved health care resulting from the e-prescription service (31), and no study has investigated the e-prescription in connection to the level of ADEs in Estonia. Reports have called for the e-prescription to provide additional functionalities and create tangible value to users (54). A positive example in this regard is the fact that as of February 2012, physicians were not able to prescribe branded medication without indicating a reason for it. This probably influenced the gradual increase of generic medication prescriptions in Estonia. The service has also given patients a better overview of their medication history. However, in our view, it is relevant for the service to develop beyond the basic mission of replacing paper prescriptions.

There are several ways in which the e-prescription can be developed further to ensure that the planned benefits will be realized. Preliminary research suggests that making the diagnoses connected to the prescribed medication visible to pharmacists could mitigate the risks of potential drug therapy problems (55). However, further research is needed on this issue, as privacy concerns must be dealt with to ensure that patient data are protected. Information in the electronic prescription about over-the-counter medication has also been found useful in preventing ADEs in elderly patients (56). Continuing studies could solve the technical and cost-related issues regarding this topic.

Furthermore, decision support functions, including automatic controls, have been successful in reducing potential adverse drug events in prescribing (57). Implementing central controls could be a cost-effective way of reducing ADEs and enhancing the quality of care. Still, alert fatigue has been an issue with some information systems, causing more negative than positive impacts (58). Moreover, electronic prescription systems could enhance patient adherence to medications by way of reminders for existing prescriptions. However, not picking up prescriptions could have multiple reasons beyond simple non-adherence (59).

The goals set forth in 2008 for the e-prescription have been achieved to a certain extent, but there is a lack of systematic analysis and a lack of indicators to evaluate the results. Evaluation frameworks can assist in guiding the implementation and evaluation of nationwide e-health services. Common guidelines facilitate the mapping of multi-faceted e-services. The use of frameworks also enables comparisons across countries and to identify the critical aspects of successful national e-health service implementations. Furthermore, frameworks can be used by policymakers in conducting pre- and post-implementation evaluations as well as identifying opportunities for improvement of services.

LIMITATIONS

The current article has several limitations. First, it has not presented an exhaustive overview of studies evaluating second-generation electronic prescription services, because it was not the primary objective of the article. Moreover, the authors have not applied strict constraints on studies published in Estonia on the e-prescription service. None of the studies have been published in peer-reviewed journals, but fall under grey literature. However,
due to the small amount of information currently available, it was decided to include all information on this topic currently existing in Estonia. The study did not attempt to conduct a cost-benefit analysis. Instead, it, focused on analyzing the documented goals, as the perceived benefits do not provide enough evidence for a rigorous cost-benefit analysis.

CONCLUSION

The Estonian nationwide second-generation e-prescription was launched in the beginning of 2010. By the end of 2013, only 3.1% of all prescriptions were paper-based. Moreover, the service has a high satisfaction rate among patients, physicians and pharmacists alike. This article serves to describe the e-prescription implementation process as well as to analyze whether the objectives set for the service in 2008 have been fulfilled.

The e-prescription service has high usability and user satisfaction, but little empirical evidence is available to support if the benefits listed at the time the service was created in 2008, have been realized. In creating the primary functionalities for a nationwide e-prescription service, mainly efficiency-related goals have been achieved. Additional functionalities will be key drivers in creating health care quality related benefits for all relevant stakeholders.

DECLARATION OF INTEREST

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ANNEX 1

Architecture and functions of the e-prescription

The e-prescription service is based on the information exchanged between several databases. The prescription process is initiated in the physician’s information system, when the physician enters a person’s identification code. This is followed by the pharmaceutical component and dosing information. On the basis of this data, the system acquires the reimbursement rate for the compound and the e-prescription is stored in the PRC database.

The patient can then visit any pharmacy in the country. The pharmacist is able to see all of the patient’s prescriptions and the patient can buy all the outstanding prescriptions on his name. A person can also purchase pharmaceuticals prescribed for someone else. Both the person purchasing the drug and the person it is prescribed to need to be identifiable. As the PRC contains all data on prescribed medication, information about paper prescriptions will have to be manually inserted by the pharmacist. Physicians’ information systems can request data on whether the prescriptions have been collected.

Technically the PRC is a database built on SAP ERP and PI-platforms that enables information to be written and processed on prescriptions and medical device cards. It communicates with external partners via the X-road where the data is exchanged through XML-based SOAP (Simple Object Access Protocol) messages. The systems is linked to the PRC and is be supported by documents in HL7 format inside the SOAP for some or all functions, depending on the health care provider’s information system’s preference. All messages are based on UTF-8 encoding.

The Estonian Government has employed uniform security standards that public sector databases and registries need to adhere to. They are based on German Information security standard and modified for the Estonian context. According to this, the PRC applies security level K3 where complete functionality of the system needs to be ensured 99.9% of the time. The maximum amount of downtime is 10 minutes per week according to national regulations (60,61).