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Development and Implementation of an Integrated Standard e-Prescription Model in Alignment with Iranian National EHR

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Abstract. The implementation of an Electronic Prescribing (EP) system offers numerous advantages in enhancing the efficiency of prescribing practices. To ensure successful implementation, a comprehensive understanding of the workflow in paper-based prescribing is crucial. In Iran, the Ministry of Health, and Medical Education (MOHME) has been actively involved in developing an EP system since 2011. The pilot results within MOHME have garnered significant support from all basic insurance organizations, primarily due to the importance of addressing financial considerations. As a result, these insurance organizations have taken the lead in the national development of the EP system, as responsibilities have shifted. The development of an Integrated Care Electronic Health Record (ICEHR or EHR) and the approach adopted by MOHME have paved the way for the creation of a standardized set of Application Programming Interfaces (APIs) based on openEHR and ISO13606 standards. These APIs facilitate the secure transfer of consolidated data from the EP systems, stored in the data warehouses of basic insurance organizations, to the Iranian EHR. This model follows an ICEHR architecture that emphasizes the transmission of this information to the Iranian EHR. This paper provides a detailed discussion of the various aspects and accomplishments related to these developments.

Keywords. Electronic Prescription (EP), Electronic Health Record (EHR), Medical errors, Data Integration, Basic Insurance Organizations

1. Introduction

E-prescription is a digital system that enables healthcare professionals to send prescriptions directly to pharmacies electronically. It eliminates the need for handwritten or printed prescriptions, making the process more efficient, accurate, and convenient [1]. With e-prescription, healthcare providers can securely transmit prescription details, including medication name, dosage, and instructions, to pharmacies[2]. This technology streamlines the prescription process, reduces errors, improves patient safety, and enhances the overall quality of healthcare services [3, 4].

E-prescription systems play a crucial role in digital health and are instrumental in improving patient safety. E-prescription systems play a crucial role in digital health and are

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instrumental in improving patient safety. E-prescription systems are gaining popularity in healthcare systems worldwide. However, there is a need for better understanding and analysis of the architecture and digital security of these systems on an international scale [1]. E-prescribing offers several benefits that contribute to improved patient safety, reduced fraud, and optimized drug information systems [5]. Firstly, it reduces the need for paper prescriptions, eliminating the risk of errors due to illegible handwriting. Secondly, it enhances patient safety by screening for drug interactions, dosing accuracy, and allergies. This helps prevent medication errors and adverse reactions [3, 6]. Additionally, e-prescribing optimizes drug information system investments by efficiently storing and accessing prescription records, saving time and resources. It also decreases administrative workload, freeing up more time for healthcare professionals to focus on patient care and consultations. Ultimately, e-prescribing facilitates better health outcomes for citizens by ensuring accurate and convenient medication management [7].

From initiating of Iranian EHR infrastructure, MOHME attempts to design the national e-prescription data model based on the international experiences and standards such as openEHR reference model, ISO13606 standard and other ISO TC215(Health Informatics) standard series [8, 9]. Therefore, in 2011, the development and pilot of e-prescription APIs were carried out in Babolsar town. The results of the pilot showed that the collaboration of stakeholders, particularly healthcare providers, and basic insurance organizations, was crucial for the success of the project. The regulation of financial issues in e-health services played a key role as well. Additionally, it was important to have policies in place to encourage all prescribers to use electronic tools. As a first step, MOHME needed to collaborate with payment organizations such as basic insurance organizations. These organizations had already developed their own e-prescription systems in their healthcare centers and were leading the way. However, due to the presence of multiple insurances in Iran with different systems and technologies, the e-prescription data was stored in decentralized warehouses without any connection to each other or national EHR. To address this, MOHME designed a set of APIs standards that were compatible with the EHR and instructed insurance organizations to transfer patient-centric data to the national EHR, known as SEPAS locally. This paper describes this process as the national model for e-prescription in Iran.

2. Methods

We conducted a literature review using MEDLINE to understand how e-prescribing frameworks are implemented globally. We identified relevant studies using MeSH terms related to electronic prescription and computerized physician order entry. We also searched for keywords related to adverse events and medical errors. The findings from these studies served as the basis for our interviews with experts to determine the necessary attributes and functions of the framework. The findings from investigations and studies were used as scientific input for an expert committee. This served as the foundation for conducting interviews with experts to determine the essential attributes and output functions of the e-prescribing framework. The preferences of the system were initially identified based on input from experts and universal work models. The initial features and functionality were defined and approved through discussions with key stakeholders, including primary and secondary insurance providers, medical schools, physicians, health centers, and private patient electronic health record (EHR) requirements. The preparation phase of our project involved emphasizing the concept of development

cooperation. We provided a set of instructions for EP systems developers, specifically those from basic insurance organizations, to adhere to. These developers were required to obtain a certificate from MOHME to demonstrate their compliance with the defined points and requirements. The points and requirements were determined using the MoSCoW strategy. The following section will provide an overview of the essential findings.

3. Results

3.1 Analyzing "As Is" vs "To Be" Model

Several web-based systems have been developed to facilitate the prescription of various types of orders, including medication, imaging, laboratory tests, physiotherapy, and other para-clinical services. In our research, we identified four distinct data models. One of these models follows the openEHR infrastructure and utilizes archetype/template modeling, which has been developed within the framework of MOHME. The remaining three models have been established by basic insurance organizations, each with its own unique approach that primarily focuses on financial management considerations. These models share common data elements but differ in their structure, as they have been developed to create data registries within each insurance organization and to support EP exclusively for their respective clients or customers. However, a national model is necessary to fulfill various requirements, ranging from financial objectives to governmental and clinical approaches, as well as improving patient safety and identifying medication errors and adverse drug events. Therefore, we recommend adopting a combined model that incorporates elements from the previous data model developed by MOHME and the models utilized by individual insurance organizations, which have been tailored to serve their specific customer base. Furthermore, by gathering EP data, it becomes feasible to electronically transmit this information to supplementary insurance companies for processing EP documents or e-reimbursement. This procedure operates through a pipeline system, where the prescription information is swiftly relayed from the MOHME to the supplementary insurance organizations.

3.2 Standard hybrid model and requirements

The complexity of developing a combined model that meets all requirements is a challenging issue. This is especially true when considering the need for basic insurance providers to transfer all their registered data to MOHME as mandated by regulations.
Table1 outlines the key requirements of every decentralized electronic EP system, which were determined based on expert opinions and consider governmental and clinical concerns using the MoSCoW approach. To effectively monitor prescription orders for patients and make informed policy decisions regarding patient safety and overall care quality, the integrated information should be able to provide the necessary facts. Additionally, careful consideration must be given to the design of data elements and the model for transitioning data to the SEPAS. As a result, a structured model, data elements, archetypes, and templates have been developed, along with non-relational databases and an API. Consequently, insurance organizations' EP systems will need to work with the standard API and transfer all patient records to SEPAS, the Iranian EHR.

Table 1. Decentralized EP requirement to joining in national data integration process.

MoSCoW	Requirements
Must-haves	‣ All EP systems must adhere MOHME instructions for e-prescribing by physicians or other prescribers, encompassing content, and data transmission to SEPAS. ‣ The systems must incorporate anti-counterfeiting mechanisms to ensure accuracy. ‣ Confidentiality must be maintained throughout all processes. ‣ All EP systems must to utilize national standard coding systems to significantly reduce medication errors and improve data integration accuracy. ‣ Safety alerts must be triggered by all EP systems.
Should-haves	‣ Within the next three years, all EP systems should aim to implement at least two-thirds of the provided guidelines. ‣ The process should be capable of verifying the validity of the EP. ‣ All EP systems should perform reliably according to predefined quality indicators. ‣ Every EP system should have access to patient medical history information retrieved from their national EHR. ‣ Safety alerts in all EP systems should be prioritized based on clinical importance, considering factors such as frequency, severity, and certainty of potential adverse effects. ‣ The systems should function with the activation of triggers, such as the absence of allergies, other medications, or other medical conditions. ‣ All EP systems should be capable of reviewing prescribers' prescribing patterns to determine if there is overprescribing or under prescribing of specific drugs for certain patient groups.
Could-haves	‣ EP systems could develop mechanisms to prevent dose miscalculations/entry errors. ‣ The systems could detect misreading of Rx codes or doses by office staff, as compatibility issues may lead to delayed prescription delivery. ‣ Compliance with EHR requirements, including coverage information and forms, is encouraged for the systems. ‣ The systems could function with activation of the trigger (i.e., absence of allergies, other medications, or other medical conditions).

4. Discussion

This paper describes the results of a proposed statewide data integration model for electronic prescribing. A set of key features that provide a standard API to integrate all stored data from the underlying insurance provider. These features consider based on international experience and expert opinion and the model design is ultimately based on Iranian EHR reference model. When calling the API, all EP data must be mapped to the openEHR structure and, if submitted successfully, the ID pair for each EP will be output as a patient ID and composition ID. These IDs indicate that this portion of patient record is being stored in SEPAS. The figure 1 shown the big schema of this model.

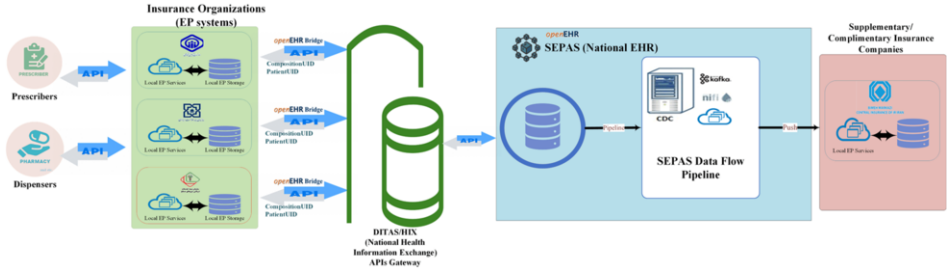

Figure1: The Comprehensive Framework of the Integration Process

With a population of over 85 million in Iran, integrating their EHRs is crucial from a national perspective. The system will facilitate decision-making for disease management, cost-benefit analysis in medicine production, import/export medicine or medical equipment and other areas. MOHME and the governance will be able to track patients, manage patient treatment who referred to healthcare centers, and make policies for the supply of additional medicines.

In addition, this system enables government executive boards to oversee the ordering practices of physicians and prescribers, while also granting supplementary insurance providers access to electronic prescriptions for e-reimbursement purposes. Although our system design is unique, its reliability has yet to be tested. In the future, there may be a need to add elements or items to the national data model structure. Further studies are necessary to assess the reliability of this system.

5. Conflicts of Interest

This project was supported by the Ministry of Health and Medical Education of Iran (MOHME). The executive results have been endorsed and confirmed by "Dr. Amin Biglarkhani", who was head of Statistics and Information Technology Office, Ministry of Health and Medical Education of Iran when the project has implemented. As teamwork, all the authors participated in project launching and they approved the final version of the manuscript.

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