http://iahsj.kaums.ac.ir/
International Archives of Health Sciences. 2024; 11(3): 152-159
https://doi.org/10.48307/iahsj.2024.414098.1054

Research Article Open Access

Physicians' use of electronic prescribing system functionalities in outpatient clinics

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Received: 14 September 2023 **Revised:** 20 March 2024 **Accepted:** 7 April 2024 **e-Published:** 1 August 2024

Abstract

Objectives: This study investigates how physicians in Iran's Social Security Organization outpatient clinics utilize EPS functionalities to optimize the system and enhance patient care.

Methods: This descriptive cross-sectional study was conducted in Iran in 2020, involving a population of 118 physicians working in outpatient clinics of the Social Security Organization. A researcher-developed questionnaire was employed to assess five different functionalities of the EPS. The validity and reliability of the questionnaire were established through expert evaluation and Cronbach's alpha calculations. Participants' responses were scored on a scale from 0 to 4 (never=0, rarely=1, sometimes=2, often=3, always=4).

Results: Physicians most frequently utilized the EPS functionalities for: "Recording and displaying patient medication history" (86.5%), "Selecting drugs from the medication list" (86.3%), "Providing pre-defined doses for selection by the physician" (66.6%), and "Alerts for repetitive treatments" (65.3%). Additionally, they reported using "Viewing and verifying prescribing information before sending electronically" (83.9%) and "Patient laboratory results" (82.2%). While features related to patient identification and data access were widely used, functionalities pertaining to alerts and decision support were utilized less frequently.

Conclusion: Physicians demonstrated a strong reliance on the core functionalities of EPS, particularly for managing medication histories, drug selection, and reviewing prescriptions prior to transmission. This reliance underscores the importance of these functionalities in streamlining workflows, reducing errors, and improving patient care. Further development of EPS can enhance their potential benefits.

Keywords: Functional Requirements, E-Prescription, Electronic Prescribing, Outpatient.

Introduction

Medical errors, particularly medication errors, pose a significant concern for healthcare systems as they can compromise patient safety and escalate healthcare costs.[1,2] Over the past decade, electronic prescribing has emerged as a popular method for physicians to manage healthcare services.[3] Despite this advancement, paper-based prescribing continues to be a prevalent source of medication errors. Common issues include inaccuracies in medication names and dosages, illegibility, non-adherence to prescribing guidelines, improper terminology, incomplete orders, labeling errors, and complications with medication delivery. Additionally, physicians often encounter challenges in accessing critical patient information, such as drug allergies, which further increases the risk of errors.[4]

Electronic systems and information technology can serve as valuable tools to address the challenges associated with paper-based prescribing.[5,6] By enabling physicians to use electronic prescribing instead of traditional methods, these systems help ensure legible and complete orders.[7] Furthermore, they assist physicians in avoiding incorrect prescriptions by recommending appropriate medication doses and sequences, displaying laboratory data, and highlighting various treatment options.[8] Studies have shown that electronic prescribing systems (EPS) can reduce the likelihood of medical errors by more than 90%.[9,10] Additional research indicates that this method decreases the occurrence of incomplete and illegible orders, minimizes typing mistakes, and enhances the accuracy and precision of medication prescribing.[7]

The Iranian Social Security Organization currently serves

over 40 million insured individuals, accounting for nearly half of Iran's population. Outpatient services represent a significant component of this healthcare delivery system, with medication treatment playing a central role.[11] Consequently, ensuring the safety of medication prescribing remains a top priority.[12] Since 2016, this organization has implemented an EPS to streamline healthcare delivery, minimize prescribing errors, and ultimately enhance patient care and safety. Given the potential for EPS to improve healthcare services, maximizing the utilization of its functionalities is essential. As the primary users of this system, physicians' comprehensive understanding of its features is critical for sustained adoption.[13]

Previous research on EPS functionalities has emphasized features such as patient information access, decision support tools, and interdepartmental communication. However, there has been limited investigation into how physicians utilize these functionalities in real-world settings.[14,15] Other studies have demonstrated that electronic prescribing is user-friendly, easy to learn, and straightforward to use.[16,17] A systematic review conducted in 2021 identified three factors-individual, organizational, and technological-that influence physicians' use of computerized physician order entry (CPOE) systems for prescribing medications.[18] Jebraeily et al., assessed the suitability of outpatient EPS features from the perspective of physicians and found limitations in specific functionalities. These included access to medication information from reliable sources, the generation of treatment options based on primary diagnoses, and the degree of system customization available.[13]

More than five years have passed since the Iranian Social Security Organization fully implemented its EPS in outpatient medical centers. Despite this widespread adoption, a significant gap remains in the research landscape. No studies have been conducted to explore how practicing physicians utilize the system's functionalities. Previous research has primarily focused on user perspectives regarding the general suitability and acceptability of EPS, without examining the specific use of features within a particular system. Understanding physician engagement with EPS functionalities is crucial for optimizing these systems. By analyzing how these functionalities are used, valuable insights can be gained for system developers and potential purchasers. Such insights can guide targeted improvements, ensuring that the EPS aligns with the real-world needs of physicians and maximizes its potential to enhance healthcare delivery.

Objectives

This study aims to thoroughly investigate how physicians in Iran's Social Security Organization outpatient clinics utilize the EPS's functionalities to optimize the system and improve patient care.

Methods

A descriptive cross-sectional study was conducted in 2020 at the outpatient clinics of the Saveh Social Security Organization in Iran. The study participants consisted of physicians with at least three years of experience using the Electronic Prescribing System (EPS). Using Cochran's formula with parameters N=196, p=0.5, q=0.5, Z=1.96, and d=0.07, the minimum required sample size was calculated to be 98 participants. A convenience sampling approach was employed to select the samples, balancing practicality with generalizability.

Following a comprehensive literature review, the functionalities of the EPS were extracted and categorized into five groups: patient identification and data access, medication prescribing, alerts and messages for prescribers, data transmission and storage, and monitoring and renewals [Table 1]. A researcher-developed questionnaire was designed based on these functionalities. The questionnaire's face and content validity were established with input from faculty members specializing in medical informatics (n=1) and health information management (n=3). Each question's validity-evaluating relevance and clarity-was assessed using a Likert scale ranging from 1 (undesirable) to 4 (completely desirable). The Content Validity Index (CVI) was calculated for each question; items scoring below 0.7 were revised or modified. Additionally, the Content Validity Ratio (CVR) was determined using Lawshe's Table,[19] with items scoring less than 0.99 being eliminated. Reliability was confirmed through the split-half method, yielding a Cronbach's alpha of 0.89.

The final questionnaire consisted of 27 questions divided into two sections: demographic characteristics (including age, gender, education level, work experience, and duration of EPS use) and physicians' utilization of EPS functionalities. Participants rated their responses on a scale from 0 to 4 (never=0, rarely=1, sometimes=2, often=3, and always=4).

The researcher distributed the questionnaires at the outpatient clinics of the Saveh Social Security Organization, inviting interested participants to complete them.

Table 1. The electronic prescribing system's functionalities descriptions

Functionalities	Descriptions
Patient identification and data access	Access to patient demographic information, such as name, gender, date of birth, or age, by a user (physician).
Medication prescribing	Ability to select drugs from the medication list and diseases diagnoses and use clinical terminology
Alerts and other messages to prescribers	Alert about drug interactions, repetitive therapies, or prioritize alerts according to their importance
Data transmission and storage	Save the prescription in the system and send it to the pharmacy electronically
Monitoring and renewals	Allows healthcare providers to efficiently track patients' medication usage over time and facilitate the renewal process for ongoing prescriptions.

Data analysis

The continuous variables were expressed as the mean±SD, and the categorical variables were presented as a percentage and frequency. All statistical analyses were performed with SPSS (version 16.0, SPSS Inc, Chicago, IL, USA). A "P-value" less than 0.05 was considered significant. The results reflecting physicians' use of electronic prescribing functionalities were reported as the sum of responses categorized as "often" and "always."

Ethical considerations

The study objectives were explained to all participants, and verbal informed consent was obtained from eligible physicians prior to their completion of the questionnaire. Participants were informed about the study aims, their voluntary participation, and the confidentiality of their responses. No personally identifiable information was collected, and stringent measures were implemented to ensure data confidentiality and security. The researcher clarified any misunderstandings regarding responses during the completion process. This study received approval from the ethics committee of Kashan University of Medical Sciences (Ethics code: IR.KAUMS.NUHEPM.REC.1399.003). The study was conducted in accordance with the Declaration of Helsinki.

Results

The results indicated that 118 physicians working in the outpatient clinics of the Social Security Organization completed the questionnaire. Among the participating physicians, 63 (53.4%) were female. The majority of participants (46.6%) were aged between 31 and 40 years, and 28.8% had work experience ranging from 5 to 10 years. Approximately 74.6% of the participants were General Practitioners (GPs). Notably, 46 physicians (39%) reported using the Electronic Prescribing System (EPS) for more than four years [Table 2].

Table 2. Participants' demographic information (n=118)

Demographic variable		Frequency (%)
Gender	Female	63 (53.4)
	Male	55 (46.6)
Age (years)	21-30	33 (28)
	31-40	55 (46.6)
	41-50	25 (21.2)
	≥50	5 (4.2)
Work experience (year)	≤5	27 (22.9)
	5-10	34 (28.8)
	10-15	27 (22.9)
	15-20	23 (19.5)
	> 20	7 (5.9)
Educational level	General Practitioner	88 (74.6)
	Specialist	30 (25.4)
Work duration with the electronic prescribing system, years	≤1	32 (27.2)
	1-2	20 (16.9)
	3-4	20 (16.9)
	> 4	46 (39)

Table 3 presents the findings regarding physicians' use of EPS functionalities. On average, physicians utilized 65% of the EPS's features, with the highest usage related to "Patient identification and data access" (95.22±4.84) and the lowest associated with "Alerts and other messages for prescribers" (55.83±20.56).

The findings revealed that physicians most frequently used the EPS functionalities for: "Recording and displaying patient medication history" (86.5%), "Selecting drugs from the medication list" (86.3%), "Reviewing the patient's current list of medications" (83.9%), "Providing pre-defined doses for selection by the physician" (66.6%), "Alerts for repetitive treatments" (65.3%), "Alerts to prevent drug interactions" (59.3%), "Viewing and verifying prescribing information before sending electronically" (83.9%), and "Patient laboratory results" (82.2%). Conversely, the study indicated that physicians made

limited use of the following functionalities: "Making a diagnosis choice from the list" (46.6%), "Using standard clinical terminology" (44.1%), "Displaying a list of medications based on the physician's diagnosis" (44%), "Prioritization alerts according to their importance" (46.6%), "Elimination of recommended drugs due to drug interactions" (40.7%), and "Editing incorrect patient information" (16.1%).

Table 3. Participants' use of the electronic prescribing system functionalities

Groups	Functionalities	Use [a] N (%)	Mean±SD [b]
Patient identification and data access	Recording and displaying patient medication history	102(86.5)	95.22±4.84
	Recording and displaying patient's current medications	99(83.9)	
	Assessing the complete list of the patient's current medications	99(83.9)	
	Selecting the patient from the physician list	98(83.1)	
	Retrieving and displaying details of the patient's previous prescriptions such as drug dose, date of prescription, and date of drug delivery from the pharmacy	97(82.2)	
	Integrating patient information with previous referral information	93(87.8)	
	Recording and displaying patient identification information	90(76.3)	
	Recording and displaying medication changes	91(77.2)	
	Recording and displaying patient clinical information	88(74.6)	
Medication prescribing	Selecting drugs from the medication list	99(83.8)	64.5±16.22
	Providing pre-defined doses for selection by the physician	78(66.6)	
	Typing the name of the drug without selecting it from the list of drugs if necessary	62(50.8)	
	Accessing and controlling pharmaceutical stock	59(50)	
	Providing pre-defined orders (PDOs)	59(50)	
	Making a diagnosis choice from the list	55(46.6)	
	Using standard clinical terminology	52(44.1)	
	Displaying a list of medications based on physician's diagnosis	52(44.1)	
Alerts and other messages to prescribers	Providing alerts for repetitive treatments	77(65.3)	55.83±20.56
	Providing alerts to prevent drug interactions	70(59.3)	
	Accessing to data and details related to each alert	62(50.8)	
	Prioritization alerts according to their importance	59(46.6)	
	Elimination of recommended drugs due to drug interactions	48(40.7)	
	Editing incorrect patient information	19(16.1)	
Data transmission and storage	Viewing and verifying prescription information before sending it electronically	99(83.9)	95±5.65
	Sending the prescription electronically to the pharmacy	91(77.1)	
Monitoring and renewals	Display of patient laboratory results	97(82.2)	94.5±3.53
	Reminding the physicians to refill the patient's prescription	92(78)	
Total Mean±SD		65.27±18.71	

[a] The results of physicians' use of electronic prescribing functionalities were reported as the sum of the "often" and "always" options.
[b] SD: Standard Division

Discussion

Analysis of physician utilization patterns revealed that the most frequently used functionalities of the EPS included recording and displaying patient medication history, selecting drugs from the medication list, reviewing patients' current medications, and choosing from pre-defined medication doses. Additionally, the EPS provided valuable decision support by offering alerts for repetitive treatments and potential drug interactions. Notably, physicians extensively utilized the functionality to view and verify prescribing information before electronically transmitting prescriptions.

Conversely, the study identified several functionalities that were underutilized by physicians. These included making a diagnosis choice from a pre-defined list, using standardized clinical terminology, displaying medication lists based on diagnoses, receiving prioritized alerts, automatically eliminating drugs due to interactions, and

editing incorrect patient information. The results indicated that the most frequent use of the EPS among physicians was for "Recording and displaying patient medication history" (86.5%). This highlights the critical role of the EPS in supporting medication reconciliation-a process essential for ensuring medication accuracy, reducing the risk of adverse drug events, and ultimately enhancing patient safety.

Samadbeik et al., found that one of the most critical elements of EPS functionality for physicians is access to patients' current medications and their medication history at the time of prescribing.[20] Supporting this notion, Grossman et al., identified access to patient medication lists as one of the most beneficial features of EPS. This advantage arises from the EPS's inherent ability to maintain more comprehensive medication histories compared to traditional paper charts.[11] Furthermore, research has demonstrated the utility of the EPS in assessing medication adherence. By leveraging medication records within the EPS, healthcare providers can readily evaluate a patient's adherence to prescribed medications.[21] A thorough review of a patient's medication history empowers physicians to address a multitude of patient concerns. This historical data provides valuable insights that can guide decisions regarding the removal, modification, or initiation of new treatment regimens.[22]

The emergence of electronic prescribing innovations has significantly improved physician access to patient medical records. This enhanced accessibility fosters a more comprehensive review of a patient's medical history, ultimately leading to improved prescribing practices and a reduction in medication errors. By readily retrieving relevant clinical data, physicians can make informed prescribing decisions, thereby optimizing patient care.

In the study, nearly half of the physicians (50.9%) utilized the "Providing Pre-defined Orders (PDOs)" functionality. EPS can involve lengthy and time-consuming processes for medication prescribing, which can be inconvenient for specialists and busy physicians. This issue can be addressed by implementing PDOs for routine prescriptions.[14] The application of this method in a healthcare facility demonstrated its potential to expedite the medication prescribing process. The results of this initiative were promising, suggesting broader applicability for streamlining workflows in similar settings.[23]

Research conducted by Curtis (UK) indicates that PDOs provide a multifaceted approach to optimizing EPS. They can enhance physician familiarity with the system's functionalities, thereby reducing medication errors associated with the learning curve. Furthermore, their use has been linked to a decrease in overall prescribing errors, likely due to the standardization of medication selection. Ultimately, PDOs can bolster physician confidence in the efficiency and accuracy of the EPS.[24]

However, the effectiveness of PDOs may be compromised by complexities in the user interface (UI), poorly designed pages and forms, font and text size issues, as well as graphics and color schemes within the EPS.[15] Therefore, while PDOs offer potential benefits in enhancing prescribing efficiency, their utilization may be influenced by various factors that require further investigation. Future research could explore the nuances of PDO usage and its impact on prescribing practices to provide a more comprehensive understanding.

Our findings revealed high utilization rates for key decision support functionalities within the EPS. Physicians frequently or always used features such as "Providing alerts for repetitive treatments" (65.3%) and "Providing alerts to prevent drug interactions" (59.3%). Supporting these findings, Jebraeily et al., reported similar results in their evaluation of EPS decision support features. Their study identified the highest user satisfaction with functionalities related to drug interaction alerts, managing medication quantities for chronic conditions, and prioritizing alerts based on both the likelihood and severity of potential issues.[13] Additionally, Altuwaijri et al., found that alerts regarding drug doses and interactions are crucial factors for the success of EPS.[25]

Reminders and alerts are critical components of decision support for healthcare providers within EPS. By leveraging connections to drug databases, EPS can deliver real-time alerts for potential drug-allergy interactions, drug-drug interactions, and drug-laboratory interactions. Furthermore, features such as dose range checking, dose adjustment prompts, and notifications for repetitive treatments support healthcare professionals in making informed prescribing decisions.[26] These functionalities ultimately contribute to a reduction in prescribing errors by highlighting potential issues.[27,28]

However, the effectiveness of these systems is questionable, and their impact on clinical outcomes remains uncertain. One study reported that the primary reason for the limited effectiveness of these alerts is alert fatigue, coupled with a high rate of irrelevant clinical alerts that lead physicians to ignore important notifications (with rates ranging from 49% to 96% in various studies).[29] Therefore, acceptance of alerts could be improved by considering factors such as the number of alerts, graphic display (in terms of color and shape), content of the alerts-

including clinical consequences-reliability of alert intensity, specific instructions on how to modify prescriptions, type of drug (limiting therapeutic drugs), repetition of alerts, and prescribing features such as physician education and level of expertise.[29]

In the present study, the results indicated that a significant percentage of physicians reported "viewing and verifying prescribing information before sending it electronically" (83.9%) and "sending prescriptions electronically to the pharmacy" (77.1%) as practices they engage in sometimes or always. These findings are consistent with those of Jebraeily et al., who identified the ability to "send prescriptions to pharmacies" as the most valued feature in their evaluation of EPS.[13] The implementation of electronic prescribing has the potential to significantly enhance the quality of care and patient safety. By streamlining the prescribing process, electronic systems can demonstrably reduce medication errors and minimize the need for prescription returns due to inaccuracies. This results in improved workflow efficiency for healthcare providers and enhanced patient satisfaction through reduced wait times and fewer delays in medication access.[30]

Furthermore, a study by McMullin et al., highlighted that utilizing these two features can decrease medication errors and increase patient safety by improving medication prescribing practices, preventing over-prescribing, reducing writing errors made by physicians, and enhancing the efficiency of pharmacists in interpreting and delivering prescriptions to patients.[31]

Our study also revealed a high utilization rate for the "display of patient laboratory results" functionality, with 82.2% of physicians reporting frequent or constant use. This finding aligns with the positive feedback reported by DesRoches et al., where 68% of physicians expressed satisfaction with the impact of EPS on emergency laboratory test ordering.[32] Additionally, research by Rabiee et al., identified nurses as the group with the highest mean score for utilizing EPS functionalities to interact with other hospital subsystems. These functionalities facilitate seamless communication with departments such as pharmacy and laboratory, fostering a more integrated workflow.[33]

Moreover, in the study conducted by Jebraeily et al., physicians assigned high scores to functionalities such as requesting tests, receiving test results, and communicating with other departments.[13] However, some studies have indicated that physicians and other end-users are concerned about the potential negative effects of EPS on their workflow and performance. They noted that requesting tests via this system may take longer than traditional paper processes. Additionally, there are apprehensions regarding constraints on clinical decision-making due to electronic guidelines, excessive reliance on pre-defined prescribing templates, and acceptance of these templates without adequate modifications.[34,35] It is clear that the development of EPS is ongoing, and there remain numerous opportunities for improvement.

This study represents the first investigation in Iran to explore physician utilization of EPS functionalities within the Social Security Organization's outpatient clinics. By identifying the most and least utilized functionalities, this study provides valuable insights that can serve as a foundation for future research aimed at enhancing the efficacy of EPS within the organization and potentially inform optimization efforts in other healthcare settings. However, the relatively small sample size (n=118), drawn from a single city, limits the generalizability of the findings to the broader physician population within the Social Security Organization or other healthcare contexts. Future research involving larger, geographically diverse samples could improve the generalizability of these findings. Additionally, the study employed a cross-sectional design, which may not capture changes in system utilization over time or account for contextual factors influencing prescribing behaviors. Furthermore, reliance on self-reported data from physicians could introduce response bias or inaccuracies. Future research should address these limitations by utilizing longitudinal designs, incorporating multiple healthcare settings, and employing objective measures of system utilization to provide a more comprehensive understanding of electronic prescribing practices.

The implications for practice involve optimizing EPS by enhancing user interfaces and tailoring implementation strategies based on physicians' utilization patterns. Healthcare providers should prioritize quality improvement initiatives to minimize medication errors and enhance patient outcomes. In terms of research, future studies should investigate the underlying reasons for physicians' varying levels of system utilization through qualitative inquiries and longitudinal analyses. Comparative research can yield insights into effective system designs and implementation strategies, informing evidence-based recommendations for healthcare organizations aiming to improve electronic prescribing practices and the quality of patient care.

Conclusions

The findings of this study reveal a strong reliance among

physicians on the functionalities provided by EPS. Notably, utilization rates were particularly high for core functionalities such as documenting and presenting patient medication histories, selecting medications from a pre-populated list, and meticulously reviewing prescription details before electronic transmission. These findings highlight the pivotal role of EPS in streamlining clinical workflows, reducing medication errors, and ultimately enhancing the quality of patient care. Further refinement and integration of these systems are essential to maximize their potential in advancing healthcare delivery and optimizing patient outcomes.

Acknowledgment

This study was supported by a grant from the Kashan University of Medical Sciences Research Council. The authors would like to express their gratitude to the physicians who participated in the study. The authors would like to thank the Clinical Research Development Unit of Kashan Shahid Beheshti hospital.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

Electronic prescribing systems: EPS;
Computerized physician order entry: CPOE;
Content Validity Index: CVI;
Content Validity Ratio: CVR;
Providing Pre-defined Orders: PDOs;
User interface: UI.

Authors' contributions

Conception and design of the study: FR, EN; Development of materials: EN, FR; Data collection: LN; Data analysis and interpretation: LN; Drafting the article: FR, EN, ShA; Revising the article critically for important intellectual content: EN, ShA; Final approval of the version to be published: FR, EN, LN, ShA. All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

Funding

None.

Role of the funding source

None.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

This study received approval from the Ethics Committee Board of Kashan University of Medical Sciences (Ethics code: IR.KAUMS.NUHEPM.REC.1399.003), and all methods were conducted in accordance with relevant guidelines and regulations, including the Declaration of Helsinki. Participation was voluntary, and informed consent was obtained verbally. All eligible physicians confirmed their participation via phone call or text message. Participants had the right to withdraw from the study at any time without facing any consequences.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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How to Cite this Article:
Rangraz Jeddi F, Nabovati E, Noormoradi L, Anvari S. Physicians' use of electronic prescribing system functionalities in outpatient clinics. Int Arch Health Sci. 2024;11(3):152-159. doi: 10.48307/iahsj.2024.414098.1054