Integrated electronic prescribing systems: pharmacists' perceptions of impact on work performance and patient safety

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Abstract: Integrated electronic prescribing systems (IEPSs) are expected to improve efficiency and safety in the management of pharmaceuticals throughout the healthcare sector. We examined the introduction of an IEPS into pharmacists' work performance with regard to impact on efficiency and patient safety. A questionnaire was distributed to all pharmacists (n = 85) in a Swedish municipality (pop. 145,000) where an IEPS had recently been introduced. The response rate was 74%. We found that, in general, the IEPS was perceived to have expedited the processing of prescriptions and reduced the risk for prescription errors, as well as the handing over of erroneous medications to patients. Pharmacists were more cautious about the residual risks for making mistakes than the pharmacist's assistants. We conclude that the introduction of an IEPS was well received by local-level pharmacy staff, but that an IEPS does not automatically reduce the need for qualified personnel in the management of pharmaceuticals.

Key-Words: electronic prescribing, pharmacist, patient safety, work performance

1 Introduction

Drug-related illnesses have been calculated to be the sixth leading cause of mortality (1). The Institute of Medicine in the USA estimates that about 7,000 people die annually due to medication errors (2). A similar situation has been reported in the UK, where about 85,000 hospital admissions every year are due to medication errors (3,4). In 2001 in Sweden, a study shown that the quantity of signed orders increased from 37% to 98 % and that the reduction of erroneous or incomplete medication orders was of approximate 73%. It is interesting to note that at the same time it is estimated that a drug related problem occurred for 28 % of all admissions in Sweden (4,5).

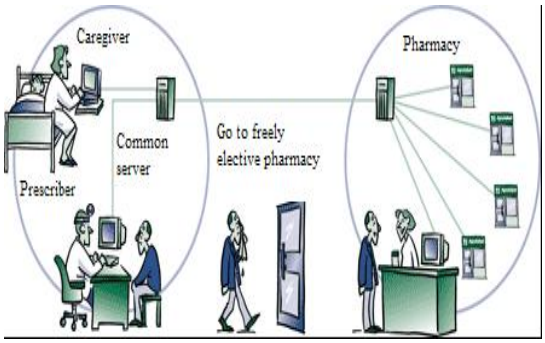

Figure 1: Structure of the Swedish national IEPS.

Healthcare organizations and pharmacy operations are run and controlled by different organizations in Sweden. The introduction of an integrated electronic prescribing system (IEPS) was a joint effort between hospitals, primary healthcare centers (PHCs), and the Swedish national pharmacy corporation already in 1993 (11). In 2007, 68% of all drug orders in the Swedish health services were transmitted electronically from physicians' offices and wards to pharmacies.

Electronic prescribing systems are expected to help the prescriber by delivering relevant patient data and information about the pharmaceuticals prescribed. At the group level, the systems provide opportunities for quality improvement, reduction of errors, and improved workflow efficiency throughout the healthcare sector (6-8). Most evaluations of electronic prescribing systems have aimed to elucidate whether computerized orders reduces medication errors and improves patient safety. However, the quality of e-prescriptions compared with non-electronic prescriptions and users' attitudes towards access to their medications on the Internet have also been investigated (9,10). The overwhelming majority of previous studies on such systems have focused on outcomes from the healthcare practice perspective.

We therefore set out to examine the introduction of an IEPS into pharmacies staff's work performance with regard to its impact on efficiency and patient safety. We also investigated the influence from professional qualification by analyzing differences between pharmacists and pharmacist's assistants.

2 Theoretical background

The Technology Acceptance Model (TAM) was developed by Fred D. Davis to explain computer-usage behavior, using as bases the Fishbein and Ajzen's Theory of Reasoned Action (12,13). The goal of TAM is "to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations". TAM has been considered as the most influential and commonly applied theory for describing individual user acceptance of information systems by researcher in the area of information systems (14-16). The scientific literature has suggested that user acceptance of new information system is the primary and critical factor in IS success and adoption (for example see (16,17).

The TAM is based on the factors relating to perceived ease of use of a system, perceived usefulness, behavioral intention to use, and actual system use. This model (TAM) assumes that an individual's acceptance of an information system is determined by two major factors or variables: perceived usefulness and perceived ease of use. Where, Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance. Perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort. Behavioral intention to use is defined as the individual's interest in using the system for future work. Perceived usefulness has a direct effect on behavioral intention to use. Perceived ease of use has a direct effect on perceived usefulness and behavioral intention to use. (14)

3 Study context

In the Swedish IEPS, an e-prescription is initiated locally through a distributed electronic prescribing network. Only certified prescribing physicians and national pharmacy personnel have access to the prescriptions loaded on the system. To generate an e-prescription, the physician indicates the patient name, the social security number, drug name, and dosage. Each prescription is then transmitted through a secure network to a national electronic prescribing mailbox at the national pharmacy (11).

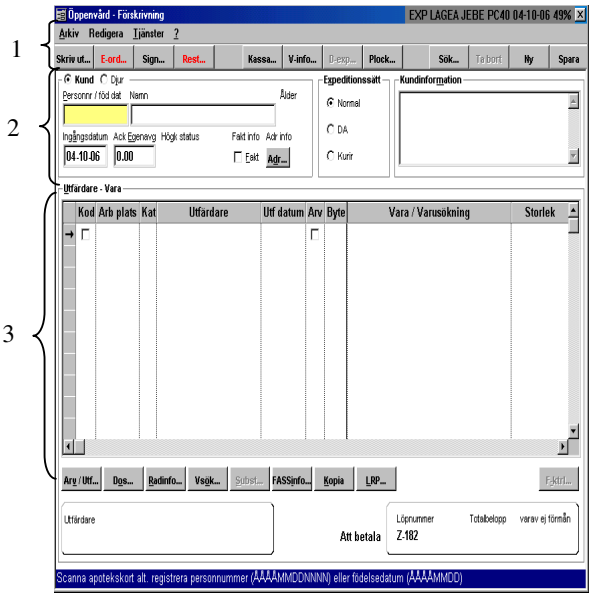

Figure 2: The pharmacist's view of the IEPS.

The patients can choose any pharmacy throughout Sweden to collect their medication. At the pharmacy, the pharmacist enters the social security number of the patient at level 2 (Figure 2). If a new e-prescription has been recorded in the system, a new prescription icon at level 1 is highlighted. After marking the prescription icon, the pharmacist can scrutinize all of the patient's other medications at level 3 before managing the actual prescription in the IEPS.

4 Methods

A survey questionnaire based on the TAM was developed to capture data relevant for the study. The questionnaire first asked for data on the demographic characteristics of the study population and their use of the IEPS in their daily work. We included questions related to the contribution of the system to improving work processes and work routine, as well as questions related to identification of the advantages and development possibilities of the system. Data were collected by asking respondents to estimate on a 5-point scale whether they agreed or disagreed with a set of statements.

To increase the likelihood that the questionnaires would serve their purpose of the study (18), the face validity of the questionnaires was assessed by a

panel of experts, four professionals with backgrounds in health informatics, pharmacology, social medicine, and statistics. The questionnaire then was revised according to their feedback and questions were re-formulated when necessary.

We distributed questionnaires to all pharmacists and pharmacist's assistants (n = 85) at the pharmacies in Linköping municipality, Sweden.

The questionnaire was distributed in November 2008. A cover letter and a return envelope with postage paid were placed in each questionnaire packet. In total, 63 out of 85 questionnaires (74%) were returned. One respondent with work experience shorter than one month was excluded from further analysis. Descriptive statistical methods were used to compute means, and frequency distributions for the data set. The results were structured by analysis area (Demographic characteristics, IEPS usefulness and ease of use, IPES impact on patient safety, IEPS advantages, and development possibilities) and professional category (pharmacists and pharmacist's assistants).

5 Results

5.1 Demographic characteristics

98.4% of the respondents were female. 47.6% were aged 51–60 years old, and 20.6% aged 41–50 years. 82.5% were pharmacists and 17.5% were pharmacist's assistants. 87.3% had more than five years' experience within their work setting, and 92.1% had more than one year's experience with IEPS.

5.2 IEPS usefulness and ease of use

Faster processing of prescriptions was the most appreciated contribution (scale 1 = low contribution to 5 = high contribution) of the IEPS, with a mean score of 4.63 (95% CI, 4.48–4.78) for the pharmacists and 4.45 (95% CI, 3.99–4.92) for the pharmacist's assistants. The other main contribution was that the system was perceived to make the work easier than when using the previous paper-based routines: mean score 4.47 (95% CI, 4.27–4.68) for pharmacists and 4.55 (95% CI, 4.19–4.90) for pharmacist's assistants (Figure 3).

The capability of the system to support all types of prescribing was perceived as a less important contribution to enhance job performance: mean score 3.59 (95% CI, 3.27–3.91) for pharmacists and 3.45 (95% CI, 2.76–4.15) for pharmacist's assistants.

Other lower ranked contributions included the capability of the system to reduce calls due to prescription ambiguity: mean score 3.73 (95% CI, 3.40–4.05) for pharmacists and 3.91 (95% CI, 3.35–4.47) for pharmacist's assistants.

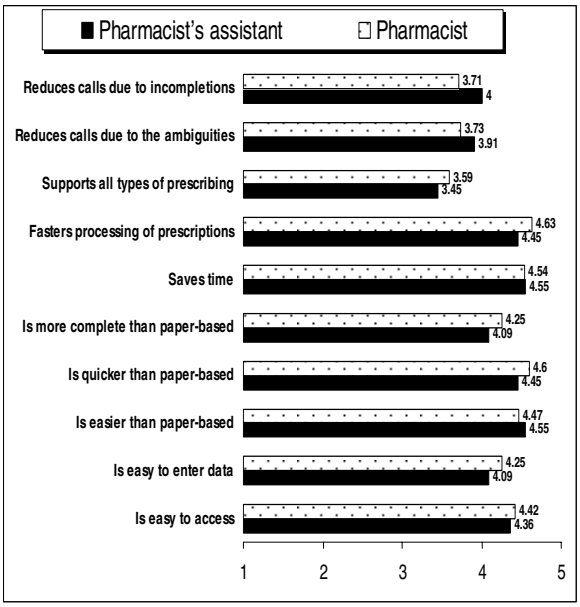

Figure 3: Perceived usefulness and ease of use of electronic prescribing on pharmacists'' work process (scale 1 = low contribution to 5 = high contribution).

5.3 IPES impact on patient safety

The respondents generally indicated that the risk for prescription errors was reduced by using the system: mean score 3.83 (95% CI, 3.53–4.11) for the pharmacists and 4.09 (95% CI, 3.62–4.56) for the pharmacist's assistants.

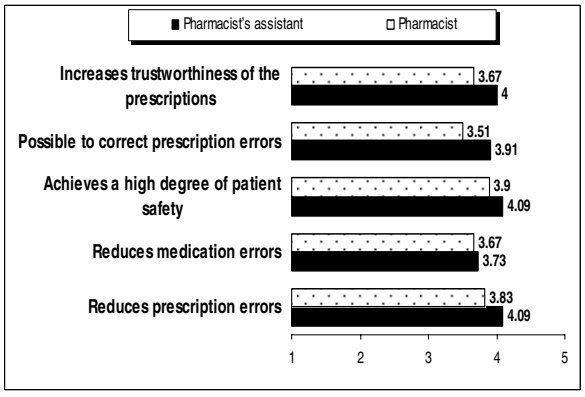

Figure 4: Perceived effects of the use of electronic prescribing on patient safety (scale 1= low contribution to 5 = high contribution).

Even though both pharmacists and pharmacist's assistants pointed to the fact that the new system contributed to an increase in patient safety and reduced prescription and medication errors, there was a tendency for the pharmacist's assistants to be

more positive towards the safety features than the pharmacists, especially regarding the "trustworthiness of the prescription" – mean score 4.00 (95% CI, 3.48–4.52) among pharmacist's assistants and 3.67 (95% CI, 3.44–3-90) for pharmacists – and making it possible to correct prescription errors: mean score 3.91 (95% CI, 3.35–4.47) among pharmacist's assistants and 3.51 (95% CI, 3.422–3.80) for pharmacists (Figure 4).

5.4 IEPS advantages

28.8% of pharmacists and 18.2% of pharmacist's assistants reported that the introduction of the IEPS had proceeded very well in their work setting, while the remaining respondents reported that the system introduction had gone well. None of the respondents indicated that the introduction had progressed badly.

Both pharmacists (82.7%) and pharmacist's assistants (90.9%) reported that forgery risk had declined by using the new IEPS (Table 1). Fewer pharmacists than pharmacist's assistants perceived that the risk for confusion of patients (61.5% and 90.9%, respectively) or drugs (63.5% and 90.9%, respectively) had been reduced.

Safety issue	Profession	Increase	No change	Decrease
Confusion of drugs	Pharmacist	9.6%	26.9%	63.5%
	Pharmacist' s assistant	0.0%	9.1%	90.9%
Confusion of patients	Pharmacist	15.4%	23.1%	61.5%
	Pharmacist' s assistant	0.0%	9.1%	90.9%
Forgery risk	Pharmacist	3.8%	13.5%	82.7%
	Pharmacist' s assistant	0.0%	9.1%	90.9%

Table 1. Perception of impact of the IEPS on selected safety issues

It is notable that more than one in 10 of the pharmacists indicated that the risks for patient confusions (15.4%) and drug confusions (9.6%) had increased. 26.9% of the pharmacists reported no difference with regard to the risk of drug confusions when using the new system.

5.5 Development possibilities

According to the respondents, the main area where the IEPS could be further developed is the loss of working hours due to computer-related problems: mean score 3.47 (95% CI, 3.16–3-78) among pharmacists and 3.78 (95% CI, 3.27–4.29) for pharmacist's assistants (Figure 5).

Also, a relative helplessness related to a general dependency on computers was indicated as a problem: mean score 3.13 (95% CI, 2.95–3.32) among pharmacists and 3.22 (95% CI, 2.88–3.56) for pharmacist's assistants.

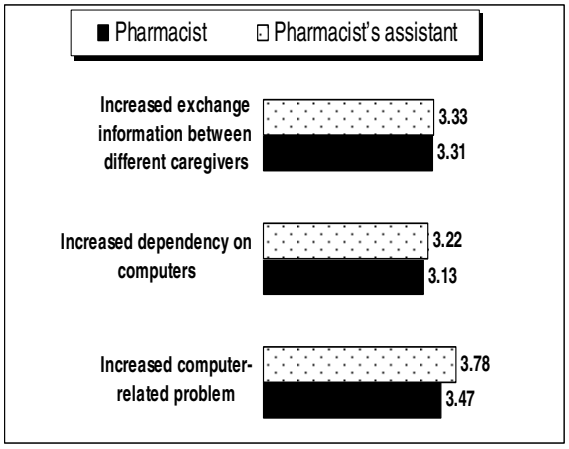

Figure 5: Perception of development possibilities for the IEPS (scale 1 = low need to 5 = high need).

6 Discussion

We set out to examine the introduction of an e-prescribing system to pharmacists' work processes with regard to impact on work efficiency and patient safety. We found that the respondents perceived that the IEPS had improved their job performance, and evaluated the system as being easy to use in their day-to-day routines.

It has previously been suggested that electronic prescribing systems can contribute to increased workflow efficiency and the availability of complete data throughout the drug prescription management process (19,20). Moreover, Barber et al. have reported that pharmacists who use an electronic prescribing system perceive the system as more convenient, with better access to patient data, and safer than the manual management of prescriptions (21). Our results are, in the main, consistent with these studies.

Perhaps the most important factor in studies related to electronic prescribing is patient safety. Investigations conducted in a variety of healthcare settings have demonstrated an increased level of patient safety as a result of the introduction of electronic prescribing systems (20). Also our results

indicate a general perception of increased patient safety and decrease in medication and prescription errors. These findings are consistent with previous studies (8,22). However, we additionally observed that the pharmacists reported more remaining concerns about patient safety when using the new system than the pharmacist's assistants, and that some of them even reported that the introduction of the IEPS had increased the risk for prescription and medication handling errors. However, as pointed out in a recent study (23,24), the introduction of a new information system in a healthcare setting always creates opportunities for error; e.g., through the man-machine interface as keystroke errors. Therefore, it is important that all types of errors are monitored and attended to.

Moreover, we found that the risks related to the confusion of drugs, confusion between patients, and forgery were perceived to have declined. However, we also observed important differences in viewpoints between pharmacists and pharmacist's assistants in regard to these matters. Pharmacists were more cautious about the residual risks for making mistakes than the pharmacist's assistants. This difference can hypothetically be both associated to the more extensive theoretical competence of the pharmacists, allowing them to identify more elaborate problems, but also to broad responsibility issues; i.e., the pharmacists have overall responsibility for the medication management routines at their pharmacy. These findings highlight that an IEPS does not automatically reduce the need for qualified staff at all levels in the management of pharmaceuticals.

Even though benefits were gained with the use of an electronic prescribing system, the respondents still claimed that computer-related problems had increased. The benefits of an electronic prescribing system will only be fully gathered if the provider organization chooses a system that has the appropriate features. The need for sufficient technical support and an effective user interface are essential factors in this context (24,25).
An important limitation in our study is that we only used quantitative data. To analyze the individual and specific consequences and problems, qualitative data could have been be more appropriate. The use of method triangulation for data collection and analysis is suggested for future studies in this area. Another limitation is that we only used descriptive statistical methods. A larger study sample would have allowed the performance of statistical tests to examine the relationships between variables.

7 Conclusion

Based on the results, we have suggestions for further research and development. The main perceived advantages of the IEPS were increased safety, smoother prescribing, better service to the patients and timesaving for all parties. Parallel use of paper-based prescription requires upholding of two parallel practices. We therefore suggest diminishing, or even totally eliminating, paper-based prescription when an IEPS is introduced. It is also crucial to continually collect and evaluate pharmacists' and physicians' feedback about the system. Thus, any organizational plan to implement computerized order entry and computerized prescribing should have a procedure incorporated for collecting and attending to users' opinions (26).

In this study, we examined pharmacists' perceptions of IEPS impact on work performance and patient safety. However, the pharmacists are only one side of the coin. Next step should be to evaluate physicians' and nurses' opinions about the computerized order entry systems they use for prescriptions at hospitals and PHCs to identify issues of importance to improve service quality and patient safety.

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