



## STUDY PROTOCOL

# Effectiveness of Health Technology in Electronic Prescription Systems: Systematic Review and Meta-Analysis Protocol

Saeed Eslami<sup>1</sup>, Hamidreza Dehghan<sup>2</sup>, Mahdiah Namayandeh<sup>3</sup>, Arezo Dehghani<sup>4</sup>, Saeed Hajian Dashtaki<sup>5</sup>, Vahid Gholampour<sup>6</sup>, Smaneh Ghasemian<sup>6</sup>, Atefeh Zare<sup>6</sup>, Masomeh Rahimi<sup>6</sup>, Abbas Barzegar<sup>7\*</sup>

<sup>1</sup>Associate Professor; Department of Informatics, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

<sup>2</sup>Department of Informatics, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

<sup>3</sup>Department of Epidemiology and Biostatistics, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

<sup>4</sup>Department of Health Management and Information Science, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran

<sup>5</sup>MSc student in Health Economics, School of Management and Medical Informatics, Esfahan University of Medical Sciences, Isfahan, Iran

<sup>6</sup>MSc student in Health Technology Assessment, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

<sup>7</sup>School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

**Corresponding Author:** Abbas Barzegar, E-mail: [barzegarabbas69@gmail.com](mailto:barzegarabbas69@gmail.com)

## ARTICLE INFO

### Article history

Received: Jul 16, 2017

Accepted: Aug 08, 2017

Published: Feb 08, 2018

Volume: 3

Issue: 1

Conflicts of interest: None

Funding: None

### Key words

Electronic Prescribing, Safety, Effectiveness, Systematic Review and Meta-Analysis

## ABSTRACT

**Introduction:** There is increasing evidence that electronic prescribing (ePrescribing) can improve the quality and safety of healthcare services. However, it has also become clear that this implementation is not straightforward and may create unintended or undesired consequences once in use. In this context, the systematic review can provide us with a general overview of the results of the studies and can help us find the truth. This review will aim to identify, appraise and synthesise clinical trial studies on ePrescribing in hospital settings. **Methods and Analysis:** Data sources will include the following databases: pubmed, scopus and cochrane library. In addition, other sources will be searched for ongoing studies (ClinicalTrials.gov) and grey literature. Studies will be independently screened for eligibility by 2 reviewers and data extraction is done by 2 people. Articles are evaluated on the basis of the quality criteria of JADAD. The data is analyzed by the STATA software. **Dissemination:** The results of the study will be published in a peer-reviewed journal and presented at relevant conferences. Policy makers and healthcare decision-makers can use these results.

## BACKGROUND

### Target

The purpose of this study is to collect evidence by systematic review and meta-analysis of the effectiveness of electronic prescribing.

### Question Framework

The structured question components are as follows:

### Population

We examined all treatment centers whose physicians used electronic prescribing technology.

### Intervention

Electronic healthcare is a new field comprising medical information, public health, and business that addresses the provision, distribution, and clarification of health and medical information through the Internet and related technologies. This concept involves comprehensive thinking and networking through the use of information and communication technologies to promote the improvement of global healthcare (1). One of the uses of electronic systems in healthcare is electronic prescribing. Electronic prescribing is one of the most commonly used and most powerful therapeutic tools available to physicians. It is a tool for distributing drugs by pharmacists and represents a substantial benefit to patients (2, 3). Currently, there are many limitations of the

handwriting prescription system; and the use of new technologies and electronic systems to overcome these limitations is a subject that has been widely studied (4).

### Comparison

Writing prescriptions by hand, with pen and paper, is a practice that is highly susceptible to error (5, 6). Preventing these errors can help reduce medical errors in general (7). Medication errors are common and result in many preventable deaths. Moreover, special health conditions that stem from an aging population and from various diseases add to this complexity (5, 6).

### Outcome

We will analyze the rate of change in medical errors, the rate of change in costs, the rate of change in medication errors, and the amount of change in the work process. We will evaluate these in terms of effectiveness.

### Study Design

Clinical trials, quasi-experimental studies

### Reasons for and Aspects of Research Innovation

An effective and legal drug prescription process is essential to the health of any modern society. It is necessary to use technical innovations, with government backing, to provide quality healthcare; and to this end, the use of electronic systems to improve the prescription process is key. Significant problems inherent in writing prescriptions by hand must be addressed and overcome, such as the rapid increase in drug costs and costly, even deadly, editorial errors (6). Currently, according to the Health Education Transformation Plan, which includes universities in Yazd, Isfahan, Kohgiluyeh and Boyerahmad, and Kashan, Iran, the mission of the 7 Pole country is one of the main priorities of health information technology. Therefore, doing more research and collecting more evidence on health information technology can be useful and valuable for the implementation of this plan. In this study, we aim to provide stakeholders with practical information on the electronic prescription system.

## METHODS

Evidence will be collected as follows:

- 1- Define the subject and research question (determining the structured questioning components at the population, intervention, comparison, outcome, and design levels)
- 2- Search for articles related to the research question
- 3- Apply inclusion and exclusion criteria for the selection of articles in the first stage (based on the title and abstract) and in the second stage (based on full text)
- 4- Evaluate the quality of selected articles (critical appraisal)
- 5- Extract data related to effectiveness and meta-analysis

### Search

- 1- Search related electronic databases to identify articles related to electronic prescription systems.
- 2- Conduct on-site review of related specialized sites in different countries. Moreover, to avoid overlapping, possibly related studies, gray sources (including reports, standards, educational guides, and online guides), communities, and internationally accredited institutions, will be searched using the Google search engine.
- 3- Review the sources of key articles related to electronic prescription systems.
- 4- If necessary, contact the authors of the articles.

### Search Strategy

To find the related articles, we will search the PubMed, Cochrane Library, and SCOPUS databases; we will consider articles published only in the last 10 years. Also, in terms of gray literature, relevant databases such as OpenSIGLE and Open Gray will be consulted. Any language limitations for article will not be considered [←“Only articles written in English will be considered”?]. Next, we will review the references of selected articles. For example, in May 2017, a PubMed search using our defined search strategy returned 110 articles.

Search strategy:

- 1: Search (Electronic Prescribing[MeSH Terms]) OR Electronic Prescribing[Title/Abstract]) OR E-Prescribing[Title/Abstract]) OR Electronic Transmission of Prescriptions[Title/Abstract]) OR Electronic Prescriptions[Title/Abstract]) OR E-Prescription[Title/Abstract])
- 2: Search (Electronic Prescribing[MeSH Terms]) OR Electronic Prescribing[Title/Abstract]) OR E-Prescribing[Title/Abstract]) OR Electronic Transmission of Prescriptions[Title/Abstract]) OR Electronic Prescriptions[Title/Abstract]) OR E-Prescription[Title/Abstract])
- 3: #1 and #2; Filters: clinical trial; published in the last 10 years

### Selection of Studies

The search and review process will be performed independently by at least two researchers. In cases of disagreement, the judgment will be made by a third researcher. After completing the search, all the articles found will be entered into EndNote, and duplicates will be deleted. Then, the titles and abstracts of the articles that meet our inclusion and exclusion criteria will be reviewed; and if the content of the article is not clear from the title and abstract, the full text will be extracted. Inclusion and exclusion criteria in the first stage will be based on the title and abstract; in the second stage, inclusion and exclusion criteria will be based on the full text of the article.

### Inclusion and Exclusion Criteria

Population: Centers that do not have an electronic prescription system will be excluded from our study.

Intervention: Studies that have not been reviewed by electronic technology will be excluded from our study.

Comparison: Studies in which electronic prescription was not compared to handwriting prescription will be excluded from our study.

Outcome: Studies that considered unrelated effects will be excluded from our study.

Design: Except for clinical trials and quasi-experimental studies, Remain articles will be excluded from our study.

### Data Extraction

Data extraction will be based on the data reported in the articles. To ensure that all researchers who participate in our study get similar data, several articles will be entered into a pilot file; and after form failures are resolved, the final form will be designed and article data will be extracted according to the designed form. The extracted form will contain several parts. The first part will contain the primary information, including title, first author's name, year, year of publication, place of study, date of study commencement and completion, and any conflicts of interest. The second part will contain information related to the population and study results. Studies will be divided for data extraction by at least two researchers, each of whom will independently extract data from the articles. After completing the data extraction forms, researchers will examine each other's forms.

### Assessment of Bias Risk in Included Studies

We will assess risk of bias in included studies using the Cochrane Collaboration's assessment tool (Higgins, 2011). We will use GRADEprofiler software to present our findings (GRADEpro, 2008). This assessment will evaluate selection bias, performance bias, detection bias, attrition bias, reporting bias, and other sources of bias, including the comparability of intervention and control group cognitive function scores at baseline, and the validity and reliability of cognitive function assessment measures.

We will use the following items to assess the risk of bias:

- random sequence generation (selection bias);
- allocation concealment (selection bias);
- blinding of participants (performance bias);
- blinding of personnel (performance bias);
- blinding of assessment of outcomes (detection bias);
- incomplete outcome data (attrition bias);
- selective outcome reporting (reporting bias);

We expect that, for many of the interventions assessed in the trials, it may be difficult to blind participants or personnel to group allocation.

Three researchers (CT, MC, and MD) will independently apply the risk-of-bias tool, and any differences will be resolved by discussion or by an additional researcher (CC or MJC). We will summarize results in a "risk of bias" graph and a "risk of bias" summary. Results of meta-analyses will be interpreted considering these findings with respect to risk of bias. If enough studies are identified (i.e., more than 10), we will examine funnel plots corresponding to meta-analyses

of cognitive functioning (the primary outcome), to assess the potential for small study effects, such as publication bias.

### Data Synthesis

If enough similar studies are available, we will address each intervention type or category (e.g., cognitive rehabilitation, physical activity, and relaxation/meditative) in separate meta-analyses. We will pool the results (of continuous or dichotomous outcomes) of similar studies in meta-analyses using the Cochrane Collaboration statistical software, Review Manager 2014. In any trials with multiple treatment groups, we will divide the "shared" comparison group into several treatment groups; comparisons between each treatment group and the divided comparison group will be treated as independent comparisons. We will use the random-effects model with inverse variance weighting for all meta-analyses (DerSimonian, 1986).

### Assessment of Heterogeneity

We will assess heterogeneity between studies by visual inspecting forest plots and by estimating the I<sup>2</sup> statistic, which will be used to calculate the percentage of statistical heterogeneity among trials that cannot be ascribed to variation in sampling. We will determine pooled estimates in different subgroups of studies to determine their consistency. We will investigate and report possible reasons for any substantial statistical heterogeneity.

### Dealing with Missing Data

We will not impute missing outcome data for cognitive functioning (the primary outcome) or for any secondary outcome. We will ask trial authors for outcome data for participants whose data were not reported or where only imputed data were reported.

### Sensitivity Analysis

We will perform sensitivity analyses by re-running analyses without studies that are deemed to have a high risk of bias.

### Study Quality

We will use the Jadad scale to evaluate the quality of clinical trials. This checklist includes three main items: Randomization, Blinding, and Describing Results. The standard [←average? normal?] score for the first and second items is 2; the standard score for the third item is 1. We will conduct an expert review of the quality of the articles. Among the issues that will be considered are the validity of the results'; the method of allocating the participants to the intervention and control groups; how the results were evaluated; and what external measures were used to determine validity.

## PRIMARY SEARCH RESULTS

According to our initial searches, it seems that studies related to the introduction of the technology are available. However,

**Table 1.** Percentage of medication errors before and after using an electronic prescription system

ID	Name	Year	Country	Sample	Before percent	After percent	Percent change	P
1	Patel (8)	2016	USA	602	20.27	12.96	7.31	P<0.05
2	Abramson (9)	2011	USA	4511	26	16	10	P=0.09
3	Manzorro (10)	2015	Spain	191	10.6	6.6	4	P=0.002
4	Westbrook (11)	2012	Australia	3291	87.16	77.93	9.23	P>0.05
5	Kaushal (12)	2010	USA	7496	42.5	6.6	35.9	P<0.001

in terms of organizational, social, and economic aspects, no studies are available.

Several studies have been conducted on electronic prescription, with the following results reported:

A 2016 study by Patel et al.: “Optimized computerized order entry can reduce errors in electronic prescriptions and associated pharmacy calls to clarify (CTC).” In this study, the authors found that medication errors decreased by 8% after the implementation of electronic prescriptions (8).

A 2011 study by Abramson et al.: “Electronic prescribing within an electronic health record reduces ambulatory prescribing errors.” In this study, the authors found that medication errors decreased by 10% after the implementation of electronic prescriptions (9).

A 2015 study by Manzorro et al.: “Effectiveness of an electronic tool for medication reconciliation in a general surgery department.” In this study, the authors found that medication errors decreased by 4% after the implementation of electronic prescriptions (10).

A 2012 study by Westbrook et al.: “Effects of Two Commercial Electronic Prescribing Systems on Prescribing Error Rates in Hospital In-Patients: A Before and After Study.” In this study, the authors found that medication errors decreased by 4% after the implementation of electronic prescriptions (11).

A 2010 study by Kaushal et al.: “Electronic Prescribing Improves Medication Safety in Community-Based Office Practices.” In this study, the authors found that medication errors decreased by 37% after the implementation of electronic prescriptions (12).

## Report

The Prisma protocol will be used to report results.

The primary search results are as follows:

## REFERENCE

- Archer N, Fevrier-Thomas U, Lokker C, McKibbin KA, Straus SE. Personal health records: a scoping review. *Journal of the American Medical Informatics Association*. 2011;18(4):515-22.
- Hellström L, Waern K, Montelius E, Åstrand B, Petersson G. Physicians' attitudes towards ePrescribing—evaluation of a Swedish full-scale implementation. *BMC medical informatics and decision making*. 2009;9(1):37.
- Joia LA, Magalhães C. Implementation of an electronic prescription system in a Brazilian general hospital: understanding sources of resistance. *The Electronic Journal of Information Systems in Developing Countries*. 2009;39.
- Lizano-Díez I, Modamio P, López-Calahorra P, Lastra CF, Segú JL, Gilabert-Perramon A, et al. Evaluation of electronic prescription implementation in polymedicated users of Catalonia, Spain: a population-based longitudinal study. *BMJ open*. 2014;4(11):e006177.
- Gagnon M-P, Nsangou É-R, Payne-Gagnon J, Grenier S, Sicotte C. Barriers and facilitators to implementing electronic prescription: a systematic review of user groups' perceptions. *Journal of the American Medical Informatics Association*. 2014;21(3):535-41.
- Samadbeik M, Ahmadi M, Asanjan SMH. A theoretical approach to electronic prescription system: Lesson learned from literature review. *Iranian Red Crescent Medical Journal*. 2013;15(10).
- Cresswell K, Coleman J, Slee A, Williams R, Sheikh A. Investigating and learning lessons from early experiences of implementing ePrescribing systems into NHS hospitals: a questionnaire study. *PLoS One*. 2013;8(1):e53369.
- Patel J, Ogletree R, Sutterfield A, Pace JC, Lahr L. Optimized Computerized Order Entry can Reduce Errors in Electronic Prescriptions and Associated Pharmacy Calls to Clarify (CTC). *Applied clinical informatics*. 2016;7(2):587-95.
- Abramson EL, Barrón Y, Quaresimo J, Kaushal R. Electronic prescribing within an electronic health record reduces ambulatory prescribing errors. *Joint Commission journal on quality and patient safety*. 2011;37(10):470-8.
- Giménez-Manzorro Á, Romero-Jiménez RM, Calleja-Hernández MÁ, Pla-Mestre R, Muñoz-Calero A, Sanjurjo-Sáez M. Effectiveness of an electronic tool for medication reconciliation in a general surgery department. *International Journal of Clinical Pharmacy*. 2015;37(1):159-67.
- Westbrook JI, Reckmann M, Li L, Runciman WB, Burke R, Lo C, et al. Effects of two commercial electronic prescribing systems on prescribing error rates in hospital in-patients: a before and after study. *PLoS Med*. 2012;9(1):e1001164.
- Kaushal R, Kern LM, Barrón Y, Quaresimo J, Abramson EL. Electronic prescribing improves medication safety in community-based office practices. *Journal of General Internal Medicine*. 2010;25(6):530-6.