

The role of computerizing physician orders entry (CPOE) and implementing decision support system (CDSS) for decreasing medical errors

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Abstract- Medical mistakes (errors) are among important challenges overall the world that threatens health systems of all countries. So, for minimizing those errors we use CPOE and CDSS systems. This study is a systematic review. The goal of this article is to investigate the last studies and findings about The role of computerizing physician orders entry (CPOE) and implementing decision support system (CDSS) for decreasing medical errors. For approaching this goal we will review articles published in databases including PubMed, Cochrane, Medline and Embase between 2006 and 2011.

Keywords: Medication error, CPOE, CDSS, reduction, decision support systems.

I. INTRODUCTION

Medical mistakes (errors) are among important challenges overall the world that threatens health systems of all countries. Movements and severe efforts have been done to reduce medical errors and mortalities, inabilities, and other consequences of medical errors [20]. Annually, medical errors cause more mortalities than by accidents, breast cancer, or HIV/AIDS [19]. These mistakes may be raise when drug administration, surgery, diagnostic, tools application, and reporting test results. Most of errors are due to complexity of healthcare systems. Lack of education and learning are not the main factors in medical errors, but the basic reason may be searched in organizations of systems lead to failure. Institute of Medicine (IOM) has reported that medical errors as the 8th reason of mortality in United States of America [2, 5].

II. Definition of medical errors

Medical errors include mistakes in drug prescription, treatment and actions, diagnostic and official and executive affairs. Mistakes in drug prescription generally rise from inability in prescription. Error may occur in any step of this process: taking history, ordering, drugstore management, official management, or controlling [2]. Drug mistakes (or adverse drug events) are the most faced among medical errors and are inevitable causes. Making mistake may occur in any step of drug delivery including: prescription, copying and duplicating physician order, drug distribution, and delivering drug to patient [4]. Studies have shown that among 44000-98000 mortality resulted from medical errors, 7000 items are due to medicinal mistakes. Annual cost for mortality and

illnesses resulted from drug errors is predicted to be about \$1.56-5.6 billion. Most of it is related to hospitalization due to unsuitable drug use or lack of proper drug delivery, wrong drug delivery and adverse drug reactions [1].

III. What factors increase medical errors?

Tiredness of treatment personnel, high work volume of physicians and nurses, chaos in work flow of a medical center, bad manuscript of doctors and illegibility of drug prescripts, business of drugstores or inaccurate examining, low carelessness by people to understand importance of these medicines, knowing their risks and maybe, insufficient description given by doctor and pharmacy's employers [5, 8, 9, 10, 12].

Two approaches are experienced all over the world for management how to confront with medical errors. First approach is one that a person is the main responsible for error and in this approach only a faulty person is looked for. Second approach is a systematic one that looks systematically to medical errors and its supporters believe that the reason and underling factor in occurring medical errors is only the healthcare system, its specifications and functions. According to this approach we must intelligently design and manage the systems and processes [1, 2].

IV. Decision supporting systems (DSS)

Decision Supporting Systems (DSS) are special computer information systems that combine information from different resources, relate them together and by this way help to decision making especially in complex problems.

Clinical decision supporting system is meeting point patient-specific information and knowledge-based information. It adds the current medical knowledge to information from patients and finally helps in deciding in medical issues [5]. In other words, this system gives consultant to physician and supports him/her in diagnosing the disease. This system minimizes the errors resulted from doctors' incorrect diagnostics. In fact, DSS is a result of Artificial Intelligence and Expert systems study developed in 1970 and 1980 decades in order to modeling clinical diagnostics. Also in those years introducing new decision systems, phase theory based systems like

CADIAG-II and networks like Internist-1/QMR have been designed and installed for overcoming the limitations existing in previous and simple systems. Also, collection coverage models, artificial neural networks and case based argument are among modern techniques developed for facing with medical diagnostic problem [15, 17, and 19].

V. Computerized Physician Order Entry

CPOE is a process which includes electronic entry of physician orders for treatment of his/her patients. These orders are transferred via a computer network to medical staff including nurses, therapists, other doctors, and also to drugstore, lab, radiography etc. [4].

That is a system that converts the manual and paper based prescription to electronic style and does not act an important role alone in decreasing medial errors. Existence of an intelligent and effective decision supporting system (DSS) along with CPOE not only will be helpful but also necessary in the field of clinical cases [6].

Nowadays, all CPOE systems are equipped by a clinical DSS. CDSS's undertake tasks like: suggesting or offering drugs' default doses, guidance for determining period of drug use and uptake way, checking medicinal allergies, checking drug's lab level, checking drug interference, notification about corollary orders like blood sugar check order once insulin prescription or blood creatinine level check once prescription of gentamicin and preparing medical guidelines while drug prescription [7].

VI. Medical guidelines

Are sets of guides that offer the best and the most information existing in the field of prevention, diagnostics, treatment and prognosis and also level of safety/risk and effectiveness costs of a medical action. So, the guidelines define the most important questions and predict all options, probable cases and results. Some of these guidelines contain decisions and computer algorithms [9, 10].

VII. The results of implementing CPOE and CDSS

Some researchers have shown that establishing CPOE decrease 80% of medical errors and 55% severe and dangerous errors. The maximum decrease is in dangerous errors and corollary orders. A report by RAND says that applying CPOE intensively in US healthcare systems will result in an annual saving about \$81billion by decreasing medical errors. Margaret et. al. reported that computerizing medical orders entry results in a decrease in medical error in intensive care and children wards [8]. Applying CPOE not only helps to reduce medical errors but also lowers the costs [9]. Another study showed that comparing manual drug orders with computerized system, all investigation reported an 80% reduction in drug prescription mistakes: 43% mistakes in drug doses and 37.5% in ADR. Implementing computerized order entry was accompanied by 66% decreasing in drug mistakes in elderly. Thus, linking CPOE to other computerized systems will make it more effective [10]. Using online guidelines along with forms of CDSS will be effective and useful to

increase patient safety and to lower recurrence of medical mistakes [12, 13]. Simultaneous application of CPOE and CDSS shows a significant drop in adverse drug reactions [14]. In addition to affecting medical errors, the system increase safety, enhance work flow effectiveness and improve the quality of services offered. A group of colleagues have made a poll from nurses and physicians and reported that 56.7% of nurses and 31% of doctors expressed that CPOE system has had good performance. A greater number of physicians in comparing to nurses (73.9%) said that the above system is not suitable with their professional tasks but despite this they are not intending to return to previous system [11]. Noting the measuring risk reduction the studies show that electronic prescription can reduce medical errors and adverse drug reactions. But for more accurate investigating and definitive commenting it is necessary to run more randomized control trails (RCTs) [9, 10].

According to KLAS only 4% of US hospitals implement CPOE system. Ondo et. al. reported that 113000 physician apply CPOE regularly and 75000 of them use that in educational hospitals only [16, 17].

VIII. Risks of CPOE

Although the main goal of establishing CPOE is to reduce medical errors but it is interesting that to know CPOE by itself leads to 22 new errors in medical field. A study in Copenhagen showed that applying CPOE with CDSS may create new medical mistakes due to it is time-consuming [6]. Insufficient experience of doctors and nurses in the beginning cause delay in entering orders and doing them. Even though this may be less important in normal wards but in wards like emergency, CCU and ICU where the quick medical actions are vital may be problematic [17].

In clinical wards physician comes to patient bed and nurse is present having patient's file. The doctor says some orders quickly and clearly and the nurse notes them. In the case of any ambiguity or question the nurse asks and removes the ambiguity. Using CPOE there is a risk that the communication of physician and nurse made slower and worsted. This occurs especially when the doctor and nurse works lonely in their work place. An investigation showed that cooperation between physician and nurse decreases after implementing this system [7, 18].

Other risk is the pseudo-safety feeling and imagination that by applying CPOE there is no possibility of mistakes. A study about NICU ward in Petersburg children hospital was showing that using CPOE leads to higher mortality in neonates. Tendency to use shortcuts or defaults has causes to use of improper drug regimes especially for elderly and low-weight persons [16]. Presence of warning and error check systems lead to repeated breakings and cause the user to be incurious and insensitive to system. It may be default doses have been defined incorrectly from beginning. In a CCU ward of a CPOE applying hospitals the suggestive dose for potassium chloride was inaccurate and leaded to frequent serious ADEs in a short fragment of time [51, 5]. Existing of inflexible ordering format causes to increase in probability of mistaken order especially

in old and nephritic patients. Also in the case of antibiotics with new species regularly introduced to market and have newer recommendations this inflexibility leads to non updated medical actions [5, 19]. Likewise the traditional paper-based system that physician may write order in a patient's file other visited one; it is possible again in CPOE system. In CPOE the existence of computers and computer applications have axial roles. Obviously, hardware failures and instabilities are risks that threaten system all the time and it is necessary to predict solutions when installing CPOE.

IX. Conclusion

In spite of many benefits of CPOE in decreasing medical errors its expansion is limited due to following reasons:

High costs of system installing and maintenance, time-consuming installation and maintenance, long time requirement for education of users, resistance of physicians and disappointment of nurses [21]

One of the biggest challenges is to convince users to safe, efficient and doctor and nurse accepted steps of entering orders [21]. Studies show that convincing physicians to use CPOE will be possible by partnership of nurses and other treatment groups in entering orders. Thus, the work load of physician is lowered and they will be more willing to use CPOE. In hospitals where CPOE works the doctors more than nurses announced that CPOE is not suitable with their professional duties. Therefore, re-designing of system and benefiting users' views are important and essential.

One can say that prerequisites for a successful CPOE are: accurate planning, continuous and flexible learning, strong partnership of personnel, using views of users, re-designing of system consistent with professional tasks, and linking to other software like CDSS and electronic guidelines.

REFERENCES

- [1] B. Dewine, "Bad writing, Wrong Medication". AHRQ web:M&M case & commentary April 2010
- [2] P. Rezaeehachesoo, Sh. Habibi, Sh. Fozonkhah, "Information Technology, an Effective Tool in Reducing and Preventing Medical Errors": Suggestions for Improvement. *Health Information Management* 2007; 4(1), pp. 89-98.
- [3] <http://www.ahrq.gov/clinic/ptsafety/chap6.htm> 2009-02-19.
- [4] S. Eslami, A. Abu-Hanna, NF. de Keizer, "Evaluation of outpatient computerized physician medication order entry systems": a systematic review. *Jam Med Inform Assoc.* 2007 Jul-Aug; 14(4), pp. 400-406.
- [5] F. Valizadeh, et al, "Errors in Medication Orders and the Nursing Staff's Reports in Medical Notes of Children", *Iran J Pediatr*; Vol 18 (Suppl 1), Dec 2008 39, pp. 33-40.
- [6] LI. Rabøl, J. Anhoj At all, "Clinical decision support: Is the number of medication errors reduced?" *Ugeskr Laeger.* 2006 Nov 27; 168(48), pp. 4179-4184.
- [7] H. Pirnejad, Z. Niazkhani, At all, "Impact of a computerized physician order entry system on nurse-physician collaboration in the medication process". *Int J Med Inform.* 2008 Nov; 77(11), pp. 735-744. Epub 2008 Jun 2.
- [8] H. Margaret, Reckmann, At all, "Does Computerized Provider Order Entry Reduce Prescribing Errors for Hospital Inpatients?" A Systematic Review, *J Am Med Inform Assoc.* 2009 Sep-Oct; 16(5), pp. 613-623.
- [9] Saeid Eslami, Ameen Abu-Hanna, F. de Keizer, "Evaluation of Outpatient Computerized Physician Medication Order Entry Systems": A Systematic Review, *J Am Med Inform Assoc.* 2007 Jul-Aug; 14(4): pp. 400-406.
- [10] A. S. Tatyana, D. Sue, "Just What the Doctor Ordered. Review of the Evidence of the Impact of Computerized Physician Order Entry System on Medication Errors", *Health Serv Res.* 2008 February; 43(1 Pt 1): pp. 32-53.
- [11] Bahlol Rahimi, Toomas Timpka, "Organization-wide adoption of computerized provider order entry systems: a study based on diffusion of innovations theory", *BMC Med Inform Decis Mak.* 2009; 9: 52.
- [12] Kuperman GJ, Teich JM, "Patient safety and computerized medication ordering at Brigham and Women's Hospital", *Jt Comm J Qual Improv.* 2006 Oct 27(10), pp. 509-521.
- [13] Judge James, At all, "Prescribers' Responses to Alerts During Medication Ordering in the Long Term Care Setting", *J Am Med Inform Assoc.* 2006 Jul-Aug; 13(4), pp. 385-390.
- [14] I. Jesse, Wolfstadt, At all, "The Effect of Computerized Physician Order Entry with Clinical Decision Support on the Rates of Adverse Drug Events": A Systematic Review, *J Gen Intern Med.* 2008 April; 23(4): 451-458.
- [15] Elske Ammenwerth, At all, "The Effect of Electronic Prescribing on Medication Errors and Adverse Drug Events": A Systematic Review, *J Am Med Inform Assoc.* 2008 Sep-Oct; 15(5): 585-600.
- [16] NIH National center for reserch resources ,Electronic health records over view ,April 2006.
- [17] R. Kaushal, KG. Shojania, DW. Bates, "Effects of computerized physician order entry and clinical decision support systems on medication safety: a systematic review", *Arch Intern Med.* 2006 Jun 23; 163(12), pp. 1409-116.
- [18] P. Vonbach, A. Dubied, S. Krahenbuhl, et al. "Prevalence of drug-drug interactions at hospital entry and during hospital stay of patients in internal medicine". *Eur J Intern Med.* 2008; 19(6), pp. 413-420.
- [19] Reza Gholami, Wrong drug and bad handwriting, *Journal of Modern Medicine*, No. 473, June 2010, pp. 260-262.
- [20] P. Rezaie Hach sou, "treatment and management of organizational processes using information technology", *health information management / th period / number of third / fall 2010*, pp.342-351.
- [21] Alireza Kazemi, et al, Physician Order Entry Or Nurse Order Entry? Comparison of Two Implementation Strategies for a Computerized Order Entry System Aimed at Reducing Dosing Medication Errors, *J Med Internet Res* 2010; 12(1):e5.