



## **Computerized Physician Order Entry System: A Review on Reduction of Medication Errors**

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### **Authors' contribution**

*This work was carried out in collaboration between all authors. Authors IQ, MTB, US and AH designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors JMA, AJ and QAP managed the analyses of the study. Authors ASM and MNT managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The advancement of computerized physician order entry system has delivered a fast social move in the realm of medication, introducing both new difficulties just as open doors for improving medicinal services. As clinicians work to adjust to the progressions forced by the CPOE, identification of best practices are required for CPOE's effective implementation. Using the references of published articles on CPOE's effective implementation and obstacles in its adherence in hospitals, this article aims to identify best practices and useful tools in effective implementation of CPOE. This review is based on a search of Medline, the Cochrane Database of Systemic Reviews, and citation lists of relevant publications. Subject heading and key words used include construction and working of CPOE, CPOE related errors, impact of CPOE on medication errors and obstacles in CPOE effective implementation. Only articles in English were included.

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## 1. INTRODUCTION

Medication prescribing errors were always known as inevitable errors in health care system which mainly includes physician's writing error which then leads to wrong dispensing error [1]. However, with advancement of information technology and introduction of electronic prescribing in the field of medicine, has shown marked decrease in prescription errors [2]. The field of Health Information Technology (HIT) has launched a system known as Computerized Physician Order Entry or Computerized Provider Order Entry (CPOE). The cornerstone of this system was set up by a collaborating facility at Wishard Memorial Hospital in 1984 for outpatients who were then extended to in-patients later in 1990 [3,4]. The intention to introduce that system was, to reduce medication errors by avoiding physicians scribbling, formulary adherence and quality services at the moment of prescription dispensing [5].

CPOE is an electronic order entry system in which clinicians enters the order for the patients and evaluates and then manipulates the outcomes of therapy [6,7]. The system allows the clinician to order through the patient's generated MR number instead of manual in-patient prescription reviews (IPR's) which in turn reduce the transcribing error [5]. The built-in formulary, ease the medication orders via generic names, proper available dosage form and right dose for the patient. The retrospective availability of patient's record makes the clinical decision easier for the physician which is the primary feature of CPOE known as Clinical Decision Support (CDS). Once the order is produced it is then processed by pharmacist or a pharmacy technician and then finally dispensed by a pharmacist [8]. With the intervention of this system the clinicians including physicians, nursing staff and clinical pharmacist can evaluate the efficacy of the treatment whether they are concerned with the Adverse Drug Reactions (ADRs) monitoring or clinical decision making [9].

CPOE is an innovation utilized by clinicians to legitimately and carefully enter drug details, laboratory findings, radiological parameters and different requests into a PC framework or cell phone, which are then transmitted electronically to the separate office or administration for execution [10]. This innovation bolsters

institutionalized, proof based and neat requests. Through clinical choice help, which can improve quality and patient security by lessening medicine and different mistakes at various phases of the request the board procedure and by maintaining a strategic reserve from repetitive testing [11]. This framework likewise quickens the requesting procedure and conveyance of care, improves productivity, and diminishes the quantity of people required to take an interest in the clinical work process, in this manner diminishing consideration delays, unfriendly occasions, and mistakes because of miscommunication and penmanship unintelligibility [12].

## 2. CONSTRUCTION AND WORKING OF CPOE

The most significant capacity of CPOE is to make it simple for the user to do the right thing for the patient and hard to do an inappropriate thing for the patient. Numerous shields are accessible in most CPOE frameworks. These important features include:

- Built in Clinical decision support system (CDSS) features.
- Drug interactions alert (For example concomitant use of Carbapenems and anti-epileptics like Valproic acid)
- Black box warning alerts
- Complete drug information

Depending on functions, physician decides to keep which feature enabled and which disable according to the need. For example drug interactions have 3 categories i.e. minor interactions, major drug interactions and contraindicated. By default all of them are enabled and pops up alert when there is any interaction of any aforementioned type. Physician can disable the minor and major interactions and enable for only contraindicated one depending upon patient's clinical condition [13].

## 3. CPOE WORKFLOW

Work process plan with CPOE is critical. It is recommended to set and define standards for the workflow process for example medicine requisition for the patient [14]. On the off chance that the user needed to put in each request exclusively via looking through the whole

requisition procedure, even a medicine order posting would turn into a strenuous procedure. Request sets spare time (if appropriately intended) to encourage a smooth work process for a requesting clinician. Some CPOE frameworks permit personalization wherein a requester can spare their inclinations for a provided request set, as in pre-set order for antibiotic posting for 5 days or 7 day course. This way clinician or requester would not have to request for every single dose and pre-set orders would save time [15]. There are anyway problems to permitting this, particularly in terms of contraindicated concomitant use. The requester could undoubtedly identify redundant postings or contraindicated concomitant use or cases of polypharmacy, for example, both omeprazole and pantoprazole order requisition for the same patient if the request set were worked with checkboxes. The user will probably be made aware of serious drug interactions if a drug choice help module is introduced, yet the normalized request sets do give some extra assurance to patients. A basic request for a solitary medicine, for example, Loratidine, ought not to require the clinician to explore pre-defined orders of every single antihistamine in pharmacy. It should rather be a "brisk pick" or "top choice" requests ought to be characterized ahead of time with complete request sentences and normal defaults proper for the clinical setting. In conclusion, the clinicians might be permitted to additionally alter these "top choices" to their own requirements for speed and productivity. Notwithstanding, as recently noted, over-dependence on a progression of "top choice" requests can risk for patient safety for standard work (medicine requisition) [16].

#### **4. FEATURE OF CLINICAL DECISION SUPPORT SYSTEM (CDSS)**

For the effective implementation of clinical practice guidelines, CPOE is featured with alerts for drug-drug interaction, drug-food interactions, drug-disease interactions which would suggest safe medication dose ranges and intervals. Built-in drug information, disease information, toxicology information and other policies and protocol would help in reducing errors and making better clinical decisions [17]. For instance, if a patient requires antibiotic therapy of Inj. Streptomycin intramuscularly and patient is thrombocytopenic, then CPOE CDSS feature of drug information alert and drug-disease interaction alert would let clinician know about

contraindication and alternative therapy as well [18].

#### **5. THE USE OF CPOE IN PREVENTING MEDICAL ERRORS**

CPOE software can be designed according to the hospital's or organization's need. The social insurance setting can actualize a framework inside the CPOE framework to diminish the primary issues which are identified regardless of whether they belong to specific age group or they are expanded clinical mistakes that happen during specific techniques. For instance, a recent report of Massachusetts clinical focus reported the possibility of inappropriate medications being prescribed to geriatric patients. Software engineers were tasked to integrate a program with the CPOE that would be capable of cautioning the doctors during medicine order placement [19]. It was discovered then the ready framework figured out how to forestall an enormous number of improper prescription requests for the geriatric patients. Also, the CPOE framework was seen as fruitful in forestalling clinical blunders at the facility [20]. Because preventable clinical mistakes and ADEs proceed to exist and have expanded from less than a hundred thousand announced cases in 2000 to more than two hundred thousand cases in 2013, it is significant for wellbeing that emergency clinics actualize a CPOE framework to be used by their clinical staff and providers [21]. Implementation of CPOE can potentially reduce drug related errors by 48 percent as per a study published in 2012 [22]. Annual Survey of American Society of Health-System Pharmacists in 2007 revealed a 12.5 percent reduction in medication errors after implementation of CPOE in 34 percent of the hospitals [23].

#### **6. OBSTACLES IN CPOE EFFECTIVE IMPLEMENTATION**

Despite of CPOE contribution towards reduction of medical errors certain obstacles like system crashes, fault in programming, inventory disruption due to item hitting issues and most of that affordability issues are major concerns. Out of all these aforementioned issues cost issues are the pressing ones. In 2005, an investigation of CPOE execution revealed that expenses could go from a "low" cost situation of \$1.3 million for usage of the framework in basic access clinics, \$2.0 million for provincial referral emergency clinics, and \$1.9 million for urban medical clinics to a "high" cost situation of about \$2.1 million for

basic access and country clinics and \$4.4 million for urban medical clinics [24]. Most of the times small organization have affordability issues despite of CPOE's influential benefits [25]. Moreover, just 30 percent of small organizations (under 100 beds) and 28 percent of organizations in rural areas have implemented CPOE, contrasted with 56 percent of enormous emergency hospitals (in excess of 400 beds) and 53 percent of research and teaching organizations with more than 20 residents [26]. By the passage of the time new errors are being highlighted and should be considered like selection of sound alike drugs for example physician wanted to post cefotaxime and instead of that posted ceftazidime. Although both are 3rd generation cephalosporins but have different spectra of activity and inappropriate selection might result in inefficacy of the treatment and resistance of antibiotics. Other errors include wrong dose entry, selection of wrong frequency and incorrect dose formulation from the drop-down menu [27]. Furthermore physicians unacceptability due to lack of time and work load is a major hurdle in CPOE's effective implementation. Physicians are ordinarily stuck in a rut and reluctant to change.

A phenomenon known as "Alert fatigue" might be overwhelming for some physicians, in which various alerts pop up built-in CDSS. Sometimes physicians ignore those alerts but that can be harmful for patient if that is life threatening alert. This obstacle can be avoided if disease specialty and age groups are defined in the system software [28]. Function of interoperability with other systems is essential in avoiding medication errors. Unfortunately, most of the CPOE systems do not have the ability to interconnect for mutual communication, and this lacking in integrated working with other systems is a great barrier in accessing the patient's complete details [29].

## 7. DISCUSSION

Technical obstructions added with the hesitation of providers and other healthcare staff in accepting new framework limit the proper utilization of CPOE framework. All of the staff, particularly the prescribers, should be taken onboard during design and implementation of CPOE system. The technical assistance for an extended period of time remain critical to sustain the interest of staff in and successful operation of CPOE. The transition from paper to electronic structure is smooth if the staff is trained and

prepared to adapt the new system. Any changes or criteria to be brought in the system should be approved by the clinical staff who will utilize the framework [30]. Additionally, the significance of including or excluding a rule in the framework should be determined according to the everyday utilization of a CPOE framework. New guidelines or improvements in existing guidelines should be aligned with regional requirements, for example, interfacing with frameworks from various sellers for data transfer among suppliers, pharmacists, payers, and pharmacy director services [31]. Standardization of terminologies should be applied. The standard use of CPOE requires word references suitable for medicine requesting. Standard wordings should likewise be set up to order medical procedures, laboratory analysis, and medications with dosing, hypersensitivities, and allergies. Since the research and reporting area is vacant with the data on CPOE's implementation barriers and benefits in Pakistan, there is dire need of research and articles on aforementioned issue, just as the significance and adequacy of CPOE as one of the main frameworks for the decrease of clinical mistakes and ADEs. Further investigations will be required to address the necessities of provincial and small organizations. Most of the available data is about large organization, yet diversity in assets may affect the procedure and the pace of CPOE implementation. At last, a deliberate audit and additionally meta-examination ought to be performed to get a more exact estimation of the advantages of and boundaries to CPOE execution [32].

## 8. CONCLUSION

CPOE implementation in hospitals is evident in improving patient care, thereby reducing the medication errors related to medicine requisitions especially. CPOE, nonetheless, has not been appeared to lessen mortality essentially. It is related with expanded time for finish of certain work processes. The most significant idea is to make it simple to make the best choice for your patient, giving protected and viable proof based clinical consideration and hard to do an inappropriate thing for the patient [33].

CPOE frameworks can possibly be a successful answer for restricting medication errors and ADEs. CPOE appropriation can encourage the decrease of clinical errors and ADEs just as making cost investment funds in hospitals. CPOE likewise provides physicians and other healthcare professionals with extra clinical

information and patient-related data that is wisely sifted and introduced aptly on times. CPOE appropriation and usage has been a piece of a far reaching procedure of refreshing and re-building whole organization's frameworks and related procedures. CPOE frameworks can be coordinated with different frameworks to build persistent security and improve the nature of patient consideration [34]. The expense of CPOE appropriation and execution is as yet a principle hindrance, particularly for small organizations. Better gauges of the money related effect of CPOE in small organizations are expected to totally survey its budgetary practicality [35]. The accomplishment of the appropriation and usage of a CPOE framework in urban hospitals relies upon cooperation among clinical staff, clinical help administrations, and the hospital organization. In particular, the foundation of the command and guidelines for important use by CMS, and the money related impetuses have advanced CPOE as a safe method of moving doctor orders that will assist organization with improving their proficiency and accomplish cost investment funds, while permitting doctors and other healthcare professionals better quality care to the patients.

## CONSENT

Not applicable.

## ETHICAL APPROVAL

Not applicable.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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