

COMPUTERIZED PHYSICIAN ORDER ENTRY (CPOE)

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Outline


- Definition and context
- Why CPOE?
- Advantages of CPOE
- Disadvantages of CPOE
- Outcome measures and examples
- Same system other outcome
- Summary

Definitions

- Computerized physician order entry (**CPOE**) is:
- The process where a medical professional entering orders or instructions electronically
- A process of electronic entry of medical practitioner instructions for the diagnosis and treatment of patients
- The process of capturing a physician's instructions for a patient's care electronically to improve the efficiency of care delivery
- Also known as Computerized Provider Order Entry or Computerized Provider Order Management (CPOM)
- .

CPOE:

- Computerized physician order entry (CPOE) is a solution to a current human system drawbacks and issues, it focuses on achieving improved quality and safety for all patients
- The process of capturing a physician's instructions for a patient's care electronically to improve the efficiency of care delivery.



What is Computerized Physician Order Entry (CPOE)?

- **Ordering** of tests, medications, and treatments for patient care using computers
- Involves electronic **communication** of the orders
- Often use rules-based methods for checking appropriateness of care
- In addition it is helping in documentation.



Main Technical Infrastructure

- EHR
- Drug information database
- DSS
- Others

CPOE, EHR and DSS

| | | |
|-----|--------------------------------------|-------------|
| EHR | Documentation knowledge resources | D S S |
| | Medication | |
| | Test reports (EKG, PFT) | |
| | Radiology, lab results | |
| | CPOE | |



Example DSS in CPOE – medication prescription

- Allergy
- Age
- Duplicate drugs on active orders,
- Severe drug interactions
 - Drug-drug, drug-diseases
- Dose maximum
- Drugs with opposite actions

What Is It?

- CPOE is a computer solution that accepts and capture physician orders including:
 - Meds
 - Laboratory Tests
 - Diagnostic Studies
 - Ancillary Support
 - Nursing Orders
 - Consults

Why Now?

- November 1999:
 - Report from the Institute of Medicine
To Err is Human: Building a Safer Health System
 - 44,000-98,000 patient deaths/year in U.S. hospitals due to medical errors
- Increased focus on **patient safety** and on **quality of care**
- CPOE is viewed as an important tool to improve **patient safety** and **quality of care** delivered

Err is Human;



- The Institute of Medicine (IOM) study “To Err is Human; Building a Safer Healthcare System”
- Adverse events occur in **2.9 to 3.7%** of all hospitalizations
- 44,000 to **98,000** patients dies a year as a result of medical errors
- Source at <http://books.nap.edu/openbook.php?isbn=0309068371>

IOM

- “the science and technologies involved in healthcare -- the knowledge, skills, care interventions, devices and drugs – have advanced more rapidly than our **ability** to deliver them **safely, effectively, and efficiently**”
 - IOM. 2001. Crossing the Quality Chasm: A New Health System for the 21st Century.

Current Objectives

- **Endorsement** of CPOE
- Establish CPOE as an Institutional Commitment and **Goal**
- Identify CPOE as a **Quality** and **Safety** Improvement Initiative

CPOE

- Bobb A, et al. The epidemiology of prescribing errors: The potential impact of CPOE. Arch Intern Med 2004;164:785 – 792.
- A CPOE with an advanced level of CDS is needed to prevent many of the prescribing errors with the greatest potential to lead to patient harm.
 - Basic = drug-allergy, drug-drug interaction & duplicate therapy checking, basic dosing guidance, formulary decision support
 - Advanced = dosing for renal insufficiency and geriatric patients, guidance for medication-related lab testing, drug-pregnancy and drug-disease contraindication checking

Reasons for CPOE

- **Order Communication**
 - **Clarity** of Orders
 - Ease of Identifying the Ordering **Physician**
- **Standardization of Care**
 - Clinically validated order sets
 - Clinical **diagnoses**
 - **Procedures**
 - Situations (post-op order sets)
- **Alerts and Reminders (Real Time Decision Support)**
 - Drug **Safety** Database (Conflict Checking)
 - Clinically validated **rules**

Medication Errors

- Two Harvard studies found that physician ordering errors accounted for 56%-78% of all preventable Adverse Drug Events

Bates et al. *JAMA* 1997;277:307-311

Kaushal et al. *JAMA* 2001;285:2114-2120

Safety & Quality Responsibilities

- Drug/Drug Interactions
- Drug/disease interactions
 - Renal dosing
 - Hepatic dosing
 - Heart failure
 - Asthma
- Pediatric/Neonatal weight based dosing
 - Weight verification (Kg vs. lb.)
- Medication Reconciliation

Medication Errors



- Physician drug ordering errors are most often due to one of two causes:
 1. Lack of **knowledge** about the drug
 - Wrong **dose**
 - Wrong **frequency**
 - Drug-drug **interaction**
 2. Incomplete patient information
 - Documented **allergies**
 - Recent lab **results**






CPOE Can Help Reduce Errors

- Brigham and Women's Hospital launched its first CPOE in 1993
- Since then, they have documented a **54%** reduction in serious medication errors
- Resulted in **62%** reduction in preventable ADE's

Improved Quality

- CPOE allows for physician reminders of best practice or evidence-based guidelines
- Indiana University study
 - Pneumococcal vaccine in eligible patients
0.8%  36.0%
 - Heparin prophylaxis
18.9%  32%

Improved Efficiency

- Maimonides Medical Center (Bronx, NY)
- 700 bed teaching hospital
- After CPOE, found substantial reduction in order processing time
 - Physician order to receipt by pharmacy
 - 3.4 hours  0.5 hours
 - Physician order to Delivery to Patient Care Area
 - 4.6 hours  1.4 hours
- Estimate of 12%  in LOS following CPOE

CPOE

- In 2005, only **4%** of hospitals are in full compliance with CPOE; 17% have made good progress.
- Government and larger teaching hospitals are more likely to have implemented CPOE.

Source: Cutler EM, Feldman NE, Hurwitz JR. US Adoption of Computerized Physician Order Entry Systems. Health Affairs 2005 Nov/Dec;24(6):1654 – 1655.

Example CPOE improves adherence to guideline

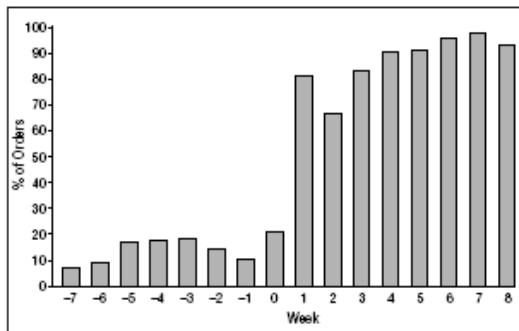


Figure 3. Change in use of nizatidine, as a percentage of all oral histamine₂-blocker orders, after the computer intervention was introduced (Week 0).

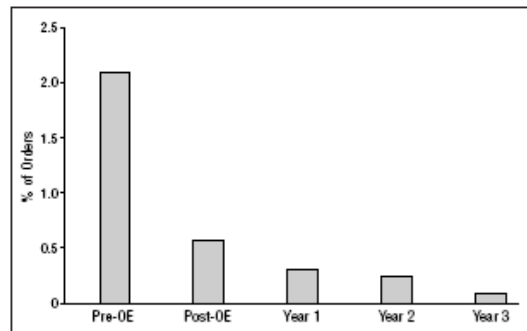
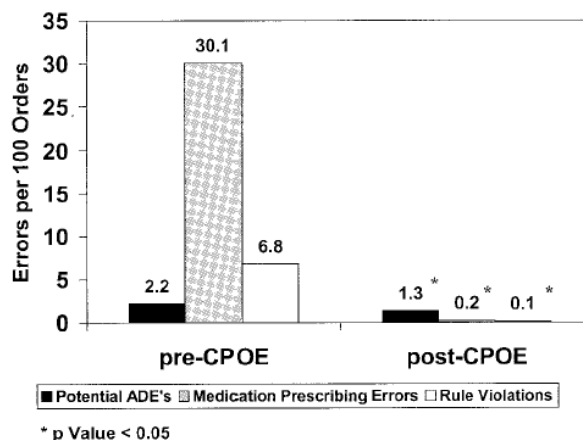


Figure 5. Percentage of medication orders with doses exceeding the recommended maximum.

Teich JM et al. Arch Intern Med. 2000 Oct 9;160(18):2713-4.

Example CPOE reduce errors

- Potts studied ADE rates in 13,828 medication orders before/after CPOE implementation at Vanderbilt Children's PICU:



Potts AL, Barr FE, et al. Pediatrics. 2004 Jan;113(1 Pt 1):59-63.

CPOE

- Effective in reducing the rate of serious medication **errors**.
- Reduction in antibiotic-related **ADEs** after implementation of decision support for these drug.
- **Length** of stay at Wishard Memorial Hospital in Indianapolis fell by 0.9 days, and hospital charges decreased by 13% after implementation of CPOE.

CPOE

- A study at Ohio State University also identified substantial reductions in pharmacy, radiology and laboratory turn-around **times**, and there was a reduction in length of stay in one of the two hospitals studied.
- Research estimates that implementation of CPOE systems at all non-rural U.S. hospitals could prevent **three** million adverse drug events each year.

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- Adverse drug events (ADEs) are the most common cause of injury to hospitalized patients and are often preventable.
- A CPOE with an advanced level of CDS is needed to prevent many of the prescribing errors with the greatest potential to lead to patient harm.
 - Basic = drug-allergy, drug-drug interaction & duplicate therapy checking, basic dosing guidance, formulary decision support
 - Advanced = dosing for renal insufficiency and geriatric patients, guidance for medication-related lab testing, drug-pregnancy and drug disease contraindication checking

Example CPOE introduces errors

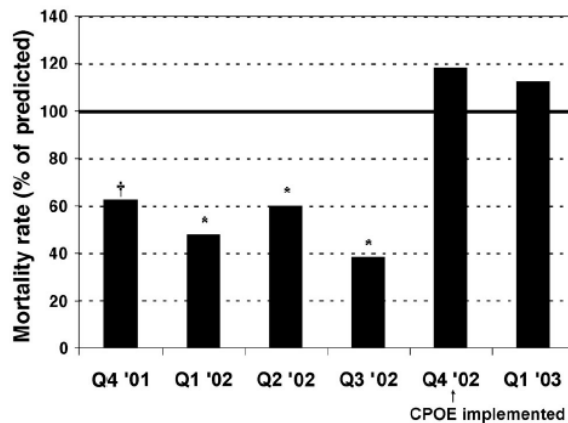
- Brigham and Womens' Hospital, Boston introduced a CPOE

| | pre | period1 | period2 | period3 |
|-----------------------------|------|---------|---------|---------|
| Potential ADEs/1000 pt-days | 15.8 | 31.3 | 59.4 | 0.5 |

- After implementation, the **rate of intercepted Adverse Drug Events (ADE) doubled!**
- Reason: The system allowed to easily order much too large dosages of potassium chloride without clear indicating that it should be given in divided doses.
- Bates et al The impact of computerized physician order entry on medication error prevention. JAMIA 1999, 6(4), 313-21.

Example CPOE introduces errors

- Association with increased PICU mortality:
 - 2.8% 14 months before CPOE
 - 6.4% 5 months after CPOE



Han YY, Carcillo JA, et al. Pediatrics. 2005 Dec;116(6):1506-12.

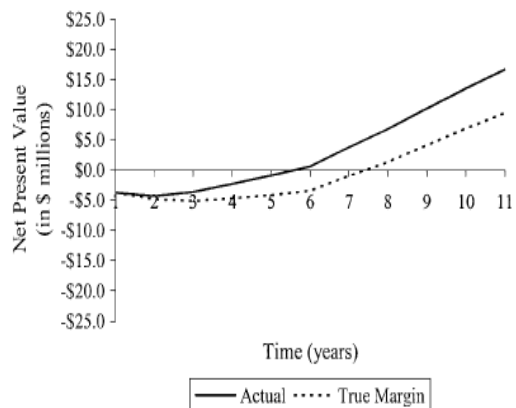
Example CPOE introduces errors

- CPOE associated errors 19% (Walsh et al. 2006)
- IT related errors 50% (Stultz and Nahata 2015)
- EHR related errors 34% (Carayon et al. 2017)


Example CPOE reduce costs

Brigham and Women's Experience: Cost-Effective

- \$3.7 million implementation
- \$ 600,000 to \$1.1 million operational costs
- Results:
 - Decreased drug costs
 - ADE cost is approximately \$4,700
 - The return on initial investment has been \$5 to \$10 million in annual savings.



Kausal R et al. J Am Med Inform Assoc. 2006; 13(3): 365-7

- 
- Full implementation of computerized physician order entry and medication related quality outcomes: a study of 3364 hospitals in 2013
 - Only 8% of US hospitals have fully implemented CPOE systems.

Challenges

- The upfront **cost** of implementing CPOE is one major obstacle for hospitals. At Brigham and Women's Hospital, the cost of developing and implementing CPOE was approximately \$1.9 million, with \$500,000 maintenance costs per year since.
- **Installation** of even "off the shelf" CPOE packages requires a significant amount of **customization** for each hospital and can be very expensive.
- **Integration** with other systems, cost, time, technical
- **Cultural** obstacles to CPOE implementation. For example, some physicians resist utilizing computerized decision-support tools, relying instead on practice experience

CPOE: Lessons From Other Institutions

1. Leadership

- Physicians need to lead the effort as the primary users
- However, CPOE is an interdisciplinary project that requires input and coordination with all clinical groups (nursing, PT/OT, Case Management, Pharmacy, Lab, Radiology, etc.) and I.T.

2. Commitment

- CPOE affects the workflow and process of **all** caregivers and ancillary departments, not just physicians
- Success requires commitment to change at all levels

3. Support

- Responsiveness and Flexibility are key
- Must be ongoing, not just at rollout



The Need for CPOE

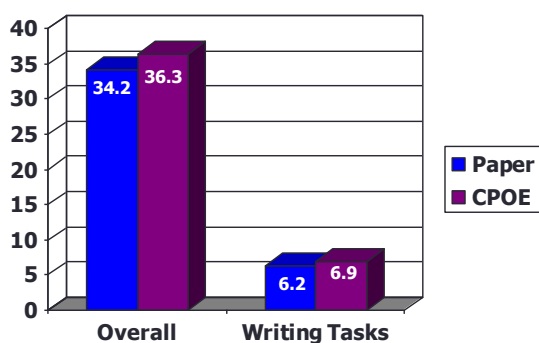
- Improved patient safety
- Improved quality
- Improved efficiency
- Reducing operating costs

CPOE

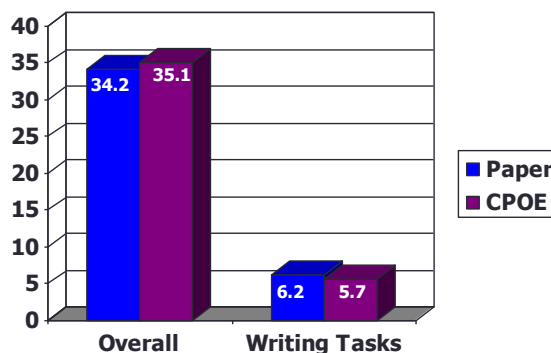
Physicians are concerned
that CPOE will take too
much time

Does CPOE Take More Time?

Time Spent/Patient Encounter (minutes)



Time Spent/Patient Encounter—
Duplicate Tasks Removed (minutes)



Evidence shows that CPOE adds less than one minute to the time physicians spent writing orders and overall only added 1-2 minutes per patient encounter. As physicians gained experience with the system, the time for orders actually decreased.

(Overhage JM, et al *J Am Med Informatics Associ* 2001;8:361-371)

CPOE

The clinical benefits for improved patient care clearly outweigh the perceived concerns.



What Is Needed For Success?

- Clinicians
 - End-users (clinicians) must be willing to champion the implementation of CPOE
 - Clinicians must be involved in design and implementation of the system
 - Clinicians must be flexible and willing to change workflow processes



What Is Needed For Success?

- Information Technology (I.T. Department)
 - Ensure fast, reliable, and easily accessible system
 - Provide ongoing support
 - Train, educate users
- Institution
 - Commitment to workflow changes

Advantages

- Improve communications
- Make knowledge more readily accessible
- Assist with calculations
- Perform checks in real time
- Assist with monitoring
- Provide decision support

What CPOE Does?

- Provides Decision Support
- Warns of Drug Interactions
 - Drug-Drug
 - Drug-Allergy
 - Drug-Food
- Checks Dosing
- Reduces Transcription Error
- Reduces number of lost orders
- Reduces duplicative diagnostic testing
- Recommends therapeutic alternatives
- Cost effective.

Example of a Local CPOE

- Comparison between CPOE and paper prescription

Study setting: the study took place at King Khalid University Hospital in the outpatient and inpatient pharmacies from October 2011 to April 2012.

Study subject: the target population for this study was handwritten and electronic prescriptions.

Study design: prospective study of randomized collection of prescriptions.

Assessment of legibility and completeness of handwritten and electronic prescriptions



ORIGINAL ARTICLE

Assessment of legibility and completeness of handwritten and electronic prescriptions

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KEYWORDS

Medication errors;
Handwritten prescription;
Electronic prescription;
Legibility

Abstract *Objectives:* To assess the legibility and completeness of handwritten prescriptions and compare with electronic prescription system for medication errors.

Design: Prospective study.

Setting: King Khalid University Hospital (KKUH), Riyadh, Saudi Arabia.

Subjects and methods: Handwritten prescriptions were received from clinical units of Medicine Outpatient Department (MOPD), Primary Care Clinic (PCC) and Surgery Outpatient Department (SOPD) whereas electronic prescriptions were collected from the pediatric ward. The handwritten prescription was assessed for completeness by the checklist designed according to the hospital prescription and evaluated for legibility by two pharmacists. The comparison between handwritten and electronic prescription errors was evaluated based on the validated checklist adopted from previous studies.

Main outcome measures: Legibility and completeness of prescriptions.

Results: 398 prescriptions (199 handwritten and 199 e-prescriptions) were assessed. About 71 (35.7%) of handwritten and 5 (2.5%) of electronic prescription errors were identified. A significant statistical difference ($P < 0.001$) was observed between handwritten and e-prescriptions in omitted dose and omitted route of administration category of error distribution. The rate of completeness in patient identification in handwritten prescriptions was 80.97% in MOPD, 76.36% in PCC and 85.93% in SOPD clinic units. Assessment of medication prescription completeness was 91.48% in MOPD, 88.48% in PCC, and 89.28% in SOPD.

The study

Data collection:

- Handwritten prescriptions were taken in the morning and in the afternoon of all the five working days.
- All e-prescribed orders were taken from inpatient pharmacy for one week.
- All handwritten prescriptions were assessed for:
 - ✓ completeness using a checklist based on the hospital prescription.
 - ✓ Legibility using 3-point legibility scoring Likert scale^[7] by two pharmacists.
- Both handwritten and electronic prescriptions were assessed for prescribing errors using checklist of errors adapted from previous studies.^[2,9,10]

Table 1: Assessment of Handwritten Prescriptions completeness

| Information assessed | No. of prescription with omission (%) |
|---|---------------------------------------|
| Patient name | 0 (0.0%) |
| Hospital no. | 0 (0.0%) |
| Sex | 64 (32.2%) |
| Age | 132 (66.3%) |
| National ID | 171 (85.9%) |
| Diagnosis | 39 (19.6%) |
| Generic name | 85 (42.7%) |
| Frequency | 3 (1.5%) |
| Dose | 20 (10.1%) |
| Duration | 2 (1.0%) |
| Route of administration | 29 (14.6%) |
| physician's name | 12 (6.0%) |
| Extension and bleep | 25 (12.6%) |
| physician's signature | 7 (3.5%) |
| Date | 12 (6.0%) |
| Clinic name | 1 (0.5%) |
| Total of prescriptions were evaluated: 199 (100%) | |

| |
|--|
| Table 2: Assessment of Handwritten Prescriptions Legibility |
|--|

| Scale* | No. of prescription (%) | | % of average scale |
|---|-------------------------|--------------------|--------------------|
| | Pharmacist A | Pharmacist B | |
| 1 | 195 (98.0%) | 156 (78.4%) | 88.2 |
| 2 | 3 (1.5%) | 27 (13.6%) | 7.5 |
| 3 | 1 (0.5%) | 16 (8.0%) | 4.3 |
| Total | 199 (100%) | 199 (100%) | 100% |
| Total of illegible and partially illegible † | 4 (2.0%) | 43 (21.6%) | 11.8% |

*1= Legible, 2= legible with effort, 3= illegible

^ pharmacist 1= expert

~ pharmacist2= new

! scale of 2 and 3

Results:

- Regarding prescribing errors, **85.9%** of handwritten prescriptions had prescribing errors whereas only **3.5%** in E-prescription system.
- Comparing the incidence of prescribing errors between electronic and handwritten prescriptions, the incidence of age errors (66.3%), unapproved abbreviation (46.7%), route of administration errors (15.1%) and dose errors (12.1%) were statistically significant.

Table 3: The Incidence and Comparison of Prescribing Errors in handwritten and Electronic prescriptions

| Type of errors | Count (% within prescription type) | | P-value |
|------------------------------------|-------------------------------------|--------------------|--------------------|
| | E-prescription prescription | Handwritten | |
| Patient`s name | 1 (0.5%) | 0 (0.0%) | 1.000 |
| Hospital no. | 1 (0.5%) | 0 (0.0%) | 1.000 |
| Age | 0 (0.0%) | 132 (66.3%) | 0.000 + |
| Dose | 2 (1.0%) | 24 (12.1%) | 0.000 + |
| Frequency | 3 (1.5%) | 6 (3.0%) | 0.503 |
| Route of administration | 0 (0.0%) | 30 (15.1%) | 0.000 + |
| Treatment duration | 0 (0.0%) | 5 (2.5%) | 0.061 |
| Medication duplication | 0 (0.0%) | 4 (2.0%) | 0.123 |
| Drug/drug interaction | 0 (0.0%) | 2 (1.0%) | 0.499 |
| Unapproved abbreviation | 0 (0.0%) | 93 (46.7%) | 0.000 + |

CPOE--Summary

- CPOE is a key component to improve Patient Safety and Quality of Care
- The focus needs to be on workflow and process of care changes that are necessary for optimal patient care, Not on implementing a new computer system
- Commitment from clinicians to help with process design and implementation is critical for success.

CPOE--Summary

CPOE is a clinical based process development to improve patient care, **not** an I.T. project

Thank you and best wishes
بالتوفيق و النجاح