Computerized Physician Order Entry

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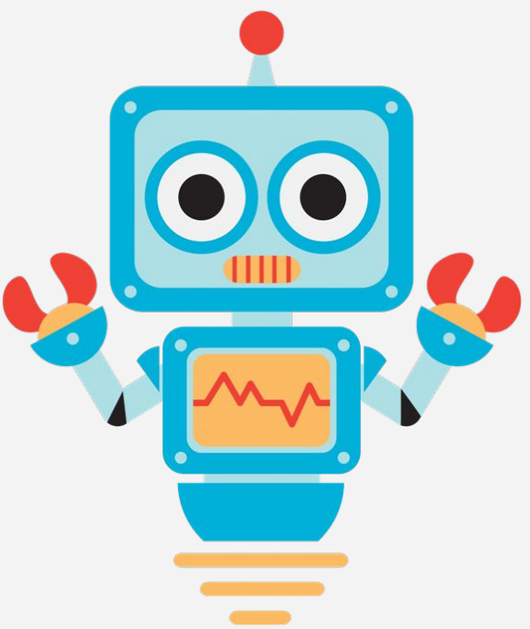
Outline

1. Definition and context
2. Why CPOE?
3. Advantages of CPOE
4. Disadvantages of CPOE
5. Outcome measures and examples
6. Same system other outcome



CPOE

Definitions

- The process where a medical professional entering orders or instructions electronically.
- A process of electronic entry of medical practitioner instructions for the treatment of patients.
- Computerized Provider Order Entry or Computerized Provider Order Management (CPOM).
- The process of capturing a physician's instructions for a patient's care electronically to improve the efficiency of care delivery.
- A solution to a current human system problem that focuses on achieving improved quality and safety for all patients. with documentation available.
- Ordering of tests, medications, and treatments for patient care using computers.
- Involves electronic communication of the orders. This orders not only placed on computer but also electronically it's been transmitted to the system.
- Often use rules-based methods for checking appropriateness of care. Examples: if you're ordering a medication for a pregnancy, you can't order it for a male because the system won't accept. OR prescribe a medication to a patient has allergy to it, the system won't accept this prescription
- CPOE is a computer application or a system that accepts physician orders
  - ✓ Meds
  - ✓ Laboratory Tests
  - ✓ Diagnostic Studies
  - ✓ Ancillary Support
  - ✓ Nursing Orders
  - ✓ Consults

CPOE has different terminologies which have the same function:
1) Computerized Physician Order Entry.
2)Computerized Provider Order Entry.
3)Computerized Provider Order Management .

- **Information system** is an arrangement and integration of:
  1. Data 2.Processes 3. People 4. Technology

  which interact to collect, process, store, and provide as output the information needed to support the organization.

What CPOE Does?

The main purpose is place orders in electronic format and a kind of support in different levels.

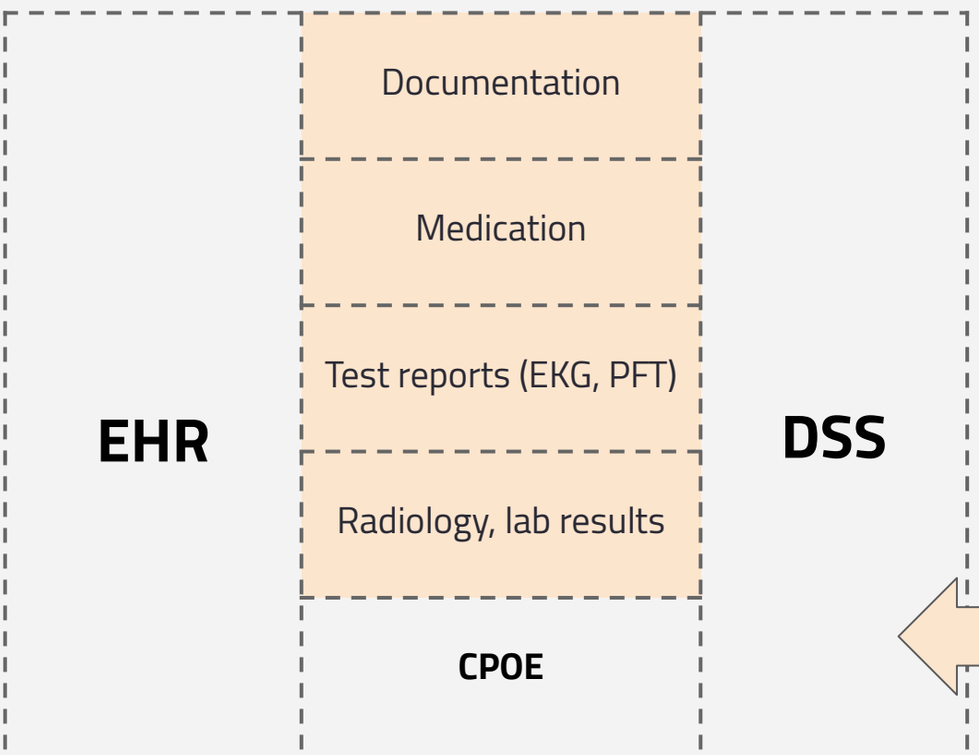
- **Provides Decision Support.** The main concern and this support comes in different levels
- Warns of Drug Interactions:
  1. Drug-Drug
  2. Drug-Allergy
  3. Drug-Food
- Checks Dosing.
- Reduces Transcription Error.
- Reduces number of lost orders. through the system
- Reduces duplicative diagnostic testing. which is in turn will save time, effort and reduce the risk of the patient
- Recommends cost effective, therapeutic alternatives.

CPOE

Technical Infrastructure:

1. EHR
2. Drug information database
3. DSS
4. Others

CPOE, EHR and DSS:



Doctor's explanation:

1. **EHR is the main infrastructure** and it is needed to place to have CPOE.
2. With EHR, we'll be to do documentation, medication, test report radiology results and lab results, but all these won't running if we don't have CPOE.
3. **DSS and CPOE** need each other, we can't do one of them alone.

Example DSS in CPOE – medication prescription:

CPOE helps a lot with prescription, so there's a function of DSS but it comes normally with CPOE.

1. Allergy. Example: while ordering antibiotic contain penicillin & the Pt have allergy to it & that's recorded in the system, so the system will stop it or alert the physician.
2. Age (check drug name and dose).
3. Duplicate drugs on active orders, not one-time.
4. Severe drug interactions (Drug-drug, drug-food).
5. Dose maximum & minimum specially for children & infants.
6. Drugs with opposite actions.

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**

Patient Safety:

- **Institute of Medicine**

➢ Report on medical errors released 1999.

➢ Estimated that between 44,000 and 98,000 hospital deaths/year are due to medical errors.

➢ Some question the accuracy of the estimates but has raised public awareness and concern

Top 10 Causes of Death 1998

1. Heart Disease 724,269
2. Cancer 538,947
3. Stroke 158,060
4. Lung Disease 114,381
5. Medical Errors 98,000
6. Pneumonia 94,828
7. Diabetes 64,574
8. Motor Vehicle 41,826
9. Suicide 29,264
10. Kidney Disease 26,295

CPOE

❖ **Medication errors** resulting in preventable ADEs most commonly occur at the prescribing stage. Bobb A, et al. The epidemiology of prescribing errors: The potential impact of CPOE. Arch Intern Med 2004;164:785 – 792.

❖ Out of 1111 **prescribing errors** were identified (6.2% errors), most occurring on admission (64%). Of these, 30.8% were rated clinically significant and were most frequently related to;

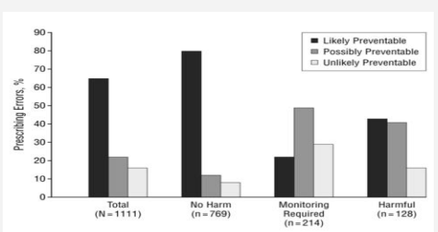
1. anti-infective medication orders,
2. incorrect dose, and
3. medication knowledge deficiency.

This is a good study outcome that showing a classification of errors & what can be managed & prevented by CPOE.

❖ 64.4% were rated as likely to be prevented with CPOE,

❖ 13.2% unlikely to be prevented with CPOE, and

❖ 22.4% possibly prevented with CPOE depending on specific CPOE system characteristics.



Severity of prescribing errors and rated preventability by use of a computerized prescriber order entry system.

Table 1. Examples of Prescribing Errors Rated as Likely, Possibly, or Unlikely to Be Prevented With Computerized Prescriber Order Entry (CPOE) and the Most Likely Proximal Cause of the Error

Classification	Examples	Proximal Cause
Likely to be prevented with CPOE	Diltiazem, 240 mg by mouth daily. Sustained-release formulation not specified.	Medication knowledge deficiency
	Unasyn (ampicillin sodium/sulbactam sodium) prescribed for a patient with a penicillin allergy (allergy documented on order).	Medication knowledge deficiency
	Fluconazole, 400 mg × 1 dose, then 200 mg daily (intravenous vs oral not specified).	Slip
Possibly prevented with CPOE	Azathioprine, 200 mg by mouth 3 times per day. Order clarified to 200 mg by mouth daily.	Medication knowledge deficiency
	Change in amikacin dose and frequency based on age, creatinine clearance, and weight.	Medication knowledge deficiency
	Chemotherapy ordered without posttherapy antiemetics (per protocol).	Slip
Unlikely to be prevented with CPOE	Hormone patch daily (patient did not know what she was taking at home).	Patient knowledge deficiency
	Order for carmustine written. Pharmacist clarified that carmustine only to be given if patient was unable to swallow hydroxyurea, which was also ordered.	Slip
	Ritonavir, 200 mg by mouth twice per day ordered. Patient was appropriately taking 400 mg by mouth twice per day prior to admission.	Transcription error

Examples of Prescribing Errors Rated as **Likely**, **Possibly**, or **Unlikely** to Be Prevented With Computerized Prescriber Order Entry (CPOE) and the Most Likely Proximal Cause of the Error.

CPOE

- **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. Which is drug basic compare.
    - **Advanced** = dosing for renal insufficiency and geriatric patients, guidance for medication-related lab testing, drug-pregnancy and drug- disease contraindication checking. Giving high level of DSS.

Reasons for CPOE

Order Communication	Standardization of Care Kind of reinforcement for clinical guidelines & checking on spot	Alerts and Reminders (Real Time Decision Support)
1. Clarity of Orders 2. Ease of Identifying the Ordering Physician	• Clinically validated order sets for: 1. Clinical diagnoses 2. Procedures 3. Situations (post-op order sets)	1. Drug Safety Database (Conflict Checking) 2. Clinically validated rules

Adverse Drug Reaction (ADR)

- Several studies have found a serious medication error in 3.4%- 5.3% of inpatients.
- The cost of a single preventable ADE is $4,685▪ $1.3 million annually for an average 300 bed hospital.

Medication Errors

- Two recent Harvard studies found that physician ordering errors accounted for 56%-78% of all preventable Adverse Drug Events. For Pt & main course among the health professionals who are committing these kinds of medical 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 the physicians aren't aware of it.
  2. Incomplete patient information when they're filling the form
     - Documented allergies
     - Recent lab results

Most Common Error Types for Clinically Significant Prescribing Errors and the Likelihood of Preventability With Computerized Prescriber Order Entry

Table 3. Most Common Error Types for Clinically Significant Prescribing Errors and the Likelihood of Preventability With Computerized Prescriber Order Entry*

Error Category	Likely Preventable	Possibly Preventable	Unlikely Preventable
Dose (n = 134)	27 (20)	69 (52)	38 (28)
Frequency (n = 69)	17 (25)	35 (50)	17 (25)
Nomenclature (n = 32)	24 (75)	7 (22)	1 (3)
Drug allergy (n = 22)	16 (73)	5 (22)	1 (5)
Incorrect medication (n = 22)	5 (23)	6 (27)	11 (50)
Omission (n = 16)	5 (31)	4 (25)	7 (44)
Duplication (n = 12)	0 (0)	10 (83)	2 (17)
Route (n = 10)	2 (20)	6 (60)	2 (20)
Drug interaction (n = 7)	3 (43)	3 (43)	1 (14)
Other (n = 18)	4 (22)	11 (61)	3 (17)
Total (N = 342)	**103** (30)	**156** (46)	**83** (24)

*Data are number (percentage) of errors. Percentages may not add to 100 due to rounding.

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 12% ⇩ in LOS following CPOE.

IOM

=institution of medicine

"The science and technologies involved in healthcare & increases in knowledge, data information, skills, care interventions, devices and drugs) have advanced more rapidly than our ability to deliver them safely, effectively, and efficiently" without considering tools like; CPOE, DSS & informatics tools

-IOM. 2001. Crossing the Quality Chasm: A New Health System for the 21st Century.

ACTIONS:

1. **Endorsement** of CPOE. To be implemented in healthcare setting.
2. **Establish** CPOE as an Institutional Commitment and Goal. It should be strategic goal for institution.
3. **Identify** CPOE as a Quality and Safety Improvement Initiative. In every healthcare sitting.

Definitions

Doctor's said: for your reference

EMR (Electronic Medical Record)	The set of databases (lab, pharmacy, radiology, clinical notes, etc.) that contains the health data & information for patients within a given institution or organization.
CDS (Clinical Decision Support) component	Software that makes relevant information available for clinical decision-making (clinical data, references, clinical guidelines, situation-specific advice) Working on the level of data, information & knowledge.
CPOE (Computerized Physician Order Entry) component	Enables clinicians to enter orders (tests, meds, dietary, etc.).
CCR (Computerized Clinical Reminder)	just-in-time (real time) reminders at the point of care that reflect evidence-based medicine guidelines.

Advantages

Important

- Improve communication between the clinician and another party
- Make knowledge more readily accessible and available for clinicians when ordering it
- Assist with calculations for dosage
- Perform checks in real time like checking for allergies
- Assist with monitoring of the performance and adherence to the guidelines and efforts of the system
- Provide decision support could be basic or advanced
- Require key pieces of information of the order to be placed (dose, e.g.)

CPOE

- In 2005, only 4% of hospitals are in full compliance with CPOE; 17% have made good progress. Towards implementation of the CPOE
- Government and larger teaching hospitals are more likely to have implemented CPOE. faster and better implementation Source: Cutler EM, Feldman NE, Hurwitz JR. US Adoption of Computerized Physician Order Entry Systems. Health Affairs 2005 Nov/Dec;24(6):1654 – 1655
- .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.
- A study at Ohio State University also identified substantial reductions in pharmacy, radiology and laboratory turnaround 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.**

Examples

Example CPOE improves adherence to guideline an advantage

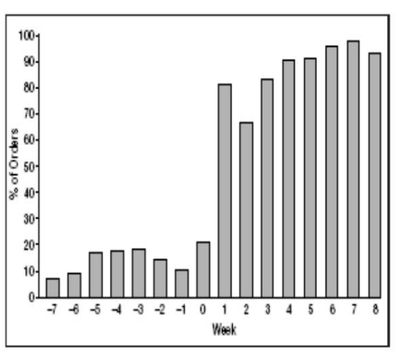


Figure 3. *Change in use of nizatidine, as a percentage of all oral histamine$_2$-blocker orders, after the computer intervention was introduced (Week 0).*

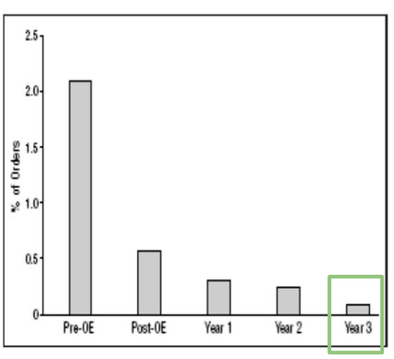
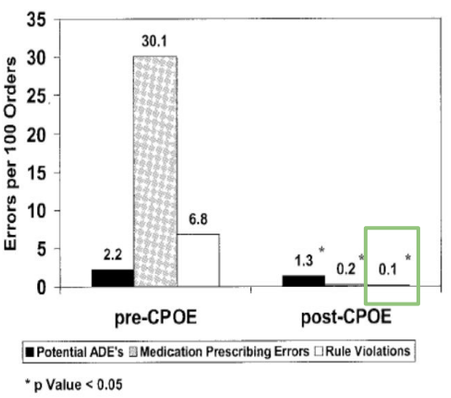


Figure 5. *Percentage of medication orders with doses exceeding the recommended maximum.*

Reduced to zero after implementation

Example CPOE reduce errors: Potts studied ADE rates in 13,828 medication orders before/after CPOE implementation at Vanderbilt Children's PICU: an advantage



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

This helped in reinforcing regulations and guidelines

Example CPOE introduces errors

1 Brigham and Women's Hospital, Boston introduced a CPOE:

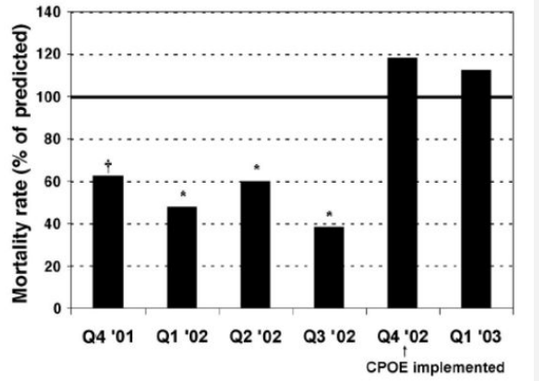
	Pre	Period1	Period 2	Period 3
Potential ADEs/1000 pt-days	15.8	31.3	59.4	0.5

- After implementation, the rate of intercepted Adverse Drug Events (ADE) **doubled**!
- **Reason:** The system allowed to easily order much too large dosage of potassium chloride without clear indicating that it 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.

Why the ADE had fall in period 3?
Because of the learning, training, customization and modification to accommodate real time situations

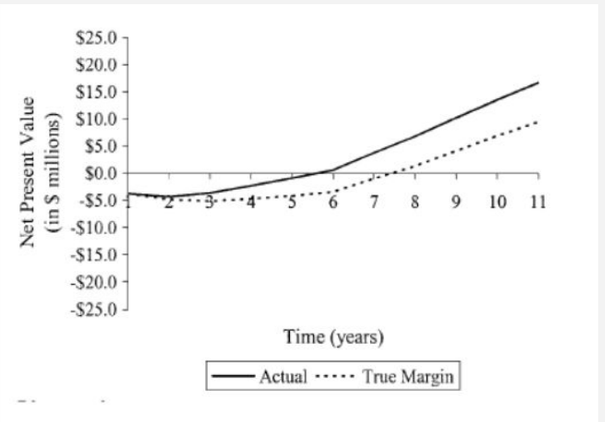
2 Association with increased PICU mortality:

- 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 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.
  - Full implementation of computerized physician order entry and medication related quality outcomes: a study of 3364 hospitals in 2013 showed that only 8% of US hospitals have fully implemented CPOE systems.. While back in 2005 it was 4%

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" ready made 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. because they think it costs them more time, it is not flexible and the workflow is not smooth

CPOE Lessons From Other Institutions

1. **Leadership**
   a. Physicians need to lead the effort as the primary users.
   b. 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** Needs management
   a. CPOE affects the workflow and process of **all** caregivers and ancillary departments, not just physicians.
   b. Success requires commitment to change at all levels.

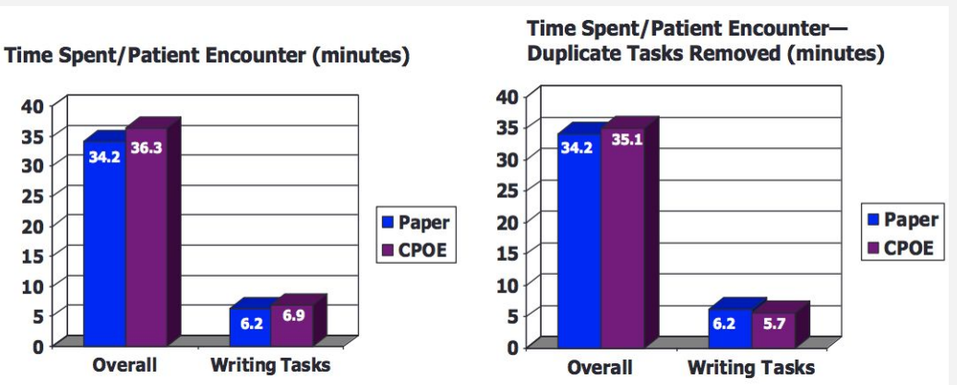
3. **Support**
   a. Responsiveness and Flexibility are key especially at the first period
   b. Must be ongoing, not just at rollout.

The Need for CPOE

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

Physicians are concerned that CPOE will take too much time.

Does CPOE Take More Time?



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.

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

What Is Needed For Success?

1. **Clinicians**:	▪ End-users (clinicians) must be willing to **champion** the implementation of CPOE. not only to use it ▪ Clinicians must be involved in design and implementation of the system. To the running of the system ▪ Clinicians must be flexible and willing to change workflow processes.
. 2. **Information Technology (I.T. Department):**	▪ Ensure fast, reliable, and easily accessible system. ▪ Provide ongoing support. at first period of implementation ▪ Train, educate users.
3. **Institution:**	▪ Commitment to workflow changes. especially financial, budget, regulations

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. not only business
- Commitment from clinicians (from all stakeholders) to help with process design and implementation is critical for success.
- **CPOE is a clinical based process development to improve patient care, not an I.T. project**

Book Summary

Computerized Physician Order Entry (CPOE)

- CPOE has the potential to reduce medication errors through a variety of mechanisms.
- It can be easily linked to drug-drug interaction warning, is more likely to identify the prescribing physician, is able to link to adverse drug event (ADE) reporting systems, can avoid medication errors like trailing zeroes, creates data that is available for analysis, can point out treatment and drugs of choice, can reduce under and over-prescribing, and allows prescriptions to reach the pharmacy quicker.

✓ **Reduce Medication Errors:**

- **Inpatient CPOE:**
  - CPOE can **decrease** serious inpatient medication errors by a relative risk reduction of 55%. However, this frequently cited article did not show reduction of potential adverse drug events (ADEs)
  - A more recent systematic review and meta-analysis suggested tha**t transition from paper-based orderin**g to **commercial CPOE systems** in ICUs was associated with an 85% **reduction in medication prescribing error** rates, but that there was mixed evidence that CPOE reduced ICU mortality. The study concluded "there is also a critical need to understand the nature of errors arising post-CPOE and how the addition of advanced CDSSs can be used to provide even greater benefit to delivering safe and effective patient care.
- **Outpatient CPOE:**
  - There is more of a chance for a medication error written for outpatients, because there are far more prescriptions written in the ambulatory setting than in acute care facilities.

✓ **Reduce Costs**

✓ **Reduce Variation of Care**

Patient safety

. Unfortunately, with implementation of most technologies new problems and issues arise that were not considered initially. EHRs are no exception to this observation and a variety of unintended (Adverse) consequences have been reported. Weiner coined the term **e-iatrogenesis** to mean **"patient harm caused at least in part by the application of health information technology."** Several studies have shown increased errors after implementing CPOE.Campbell et al. outlined nine examples of unintended consequences related to CPOE implementation:

1. "More work for clinicians
2. Unfavorable workflow changes
3. Never ending demands for system changes
4. Conflicts between electronic and paper-based systems
5. Unfavorable changes in communication patterns and practices
6. Negative user emotions
7. Generation of new kinds of errors
8. Unexpected and unintended changes in institutional power structure
9. Overdependence on technology"

-Alert fatigue is another **common unintended** consequence related to CPOE

-In response to concerns **AHRQ** released the monograph Guide to Reducing Unintended Consequences of Electronic Health Records in 2011. This Guide discusses **unanticipated** and **undesirable consequences** of EHR implementation.

Questions

1- Which of the following falls under clinical aspect of informatics?
A. CME
B. CPOE
C. E-learning

2- Which of the following is advanced Computerized physician orders entry?
A. Dosing for renal insufficiency
B. Drug-drug interaction
C. Basic dosing guidance
D. Duplicate therapy checking

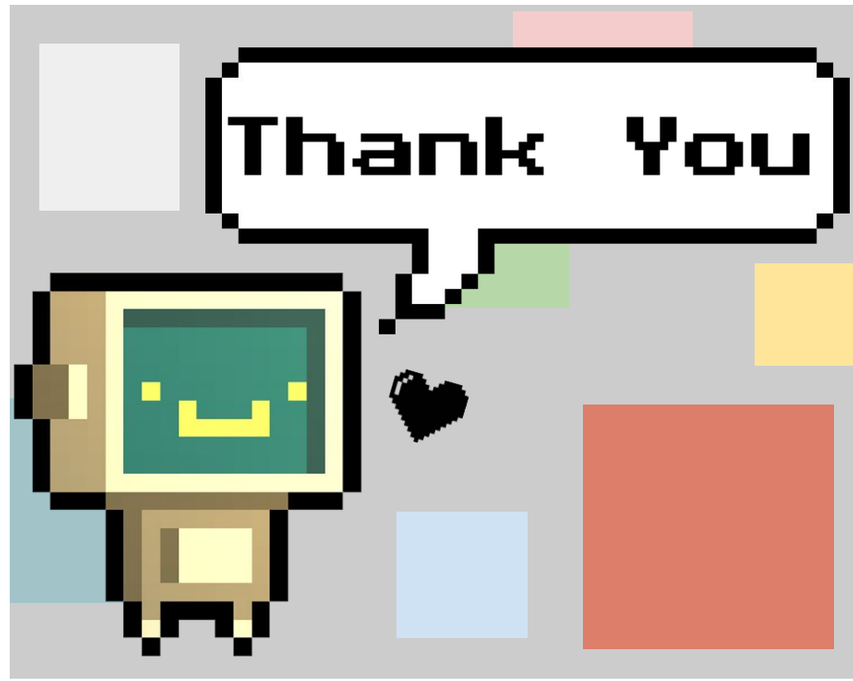
3- Which of the following is an example of basic type of CPOE?
A. drug disease contraindications
B. drug duplication check
C. drug pregnancy contraindications

4- Which of the following is one of the main advantages of EHR?
A) Fast project implementation
B) Low implementation cost
C) One time training
D) Multiple users at a time

5- Which of the terms below is interchangeable with EMR?
A) Personal health record
B) Computerized physician order entry
C) Clinical decision support system
D) Computer-based patient record

6- An electronic prescription was entered in a wrong patient record. The prescribed patient was affected by the wrong prescribed medication. This is an example of what type of error?
A. Intercepted adverse drug event
B. Near miss / close call
C. Potentially Adverse drug event.
D. Preventable adverse drug effect

1)B
2)A
3)B
4)D
5)D
6)D



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