

# Inpatient Medication Entry (IPMOE) for enhancing Safety and Efficacy of Medication Management

I T Lau  
Chief of Service (Medicine) &  
Project Lead for IPMOE Implementation  
Tseung Kwan O Hospital

# Medication errors: a major patient safety issue

- \* 82% of American adults take at least one medication and 29% take five or more.
- \* The USA-based Institute of Medicine (IOM) estimates that one medication error occurs per hospitalized patient per day.
- \* 700,000 emergency department visits and 120,000 hospitalizations are due to ADEs annually.
- \* About 15% of the prescribing errors reach patients; the others are caught in time by pharmacists and other health-care workers.
- \* \$3.5 billion is spent on extra medical costs of ADEs annually.

# Computerized Provider Order Entry (CPOE)

- \* Use of computer assistance to directly enter orders from a computer or mobile device. The order is also documented or captured in a digital, structured, and computable format.
- \* At the minimum, ensures standardized, legible and complete orders, thereby reducing errors at ordering and transcribing.
- \* The Institute of Medicine identified Medication Order Entry (MOE) as an answer to improving medication safety for a long time (2000).
- \* The Health Information Technology for Economic and Clinical Health Act (HITECH) 2009 set Meaningful Use of and incentivized EHR adoption for Medicare and Medicaid. CPOE is the first of the core requirements of Meaningful Use

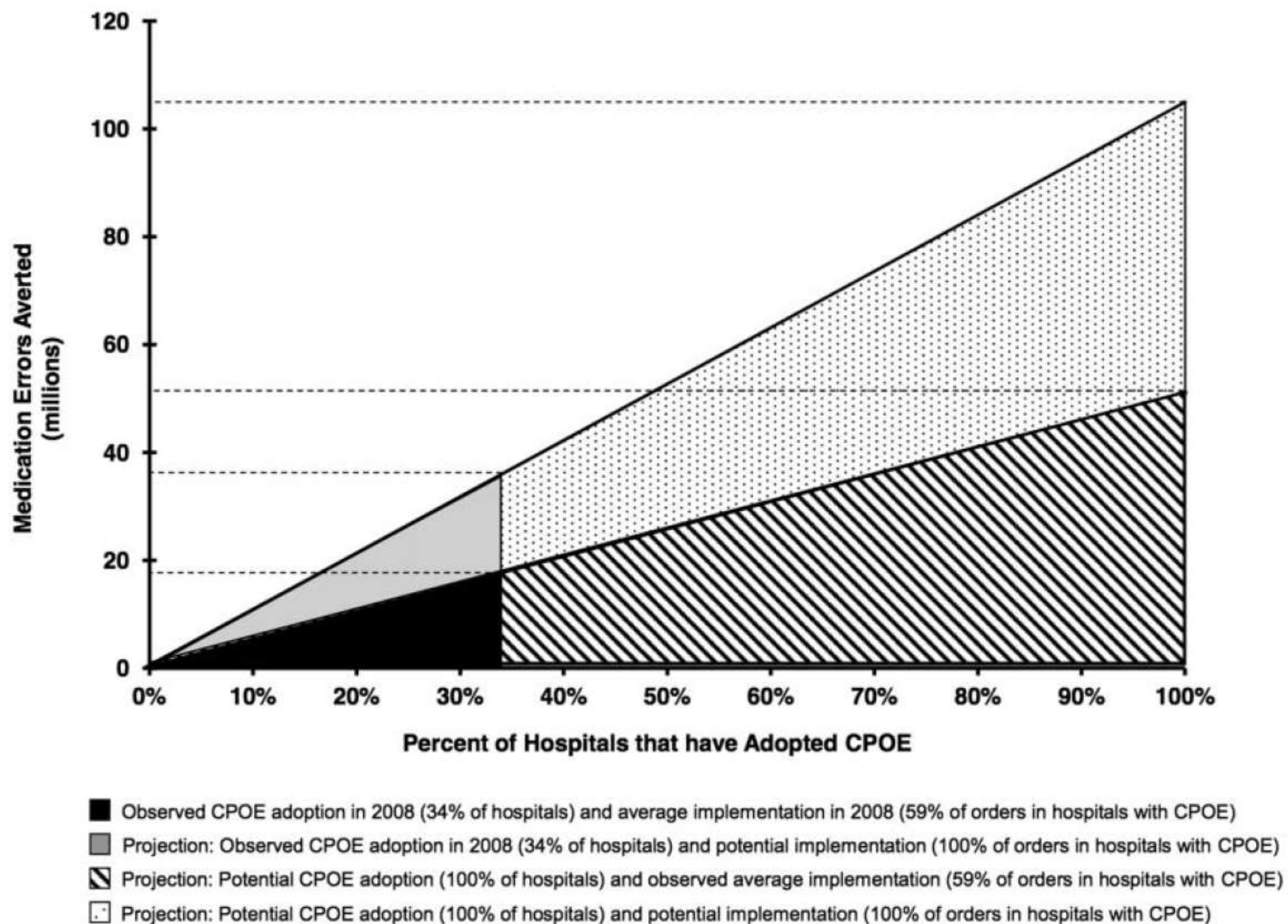
# CPOE

- \* Commercially available through vendors vs. in-house developed
- \* Variable designs:
  - \* Standalone vs. integrated into a wider clinical information or electronic patient record system
  - \* Confined to ordering (prescription) vs. downstream electronic processing of orders, i.e. open vs. closed loop
  - \* Whether combined with a clinical decision support (CDS) system of variable complexity

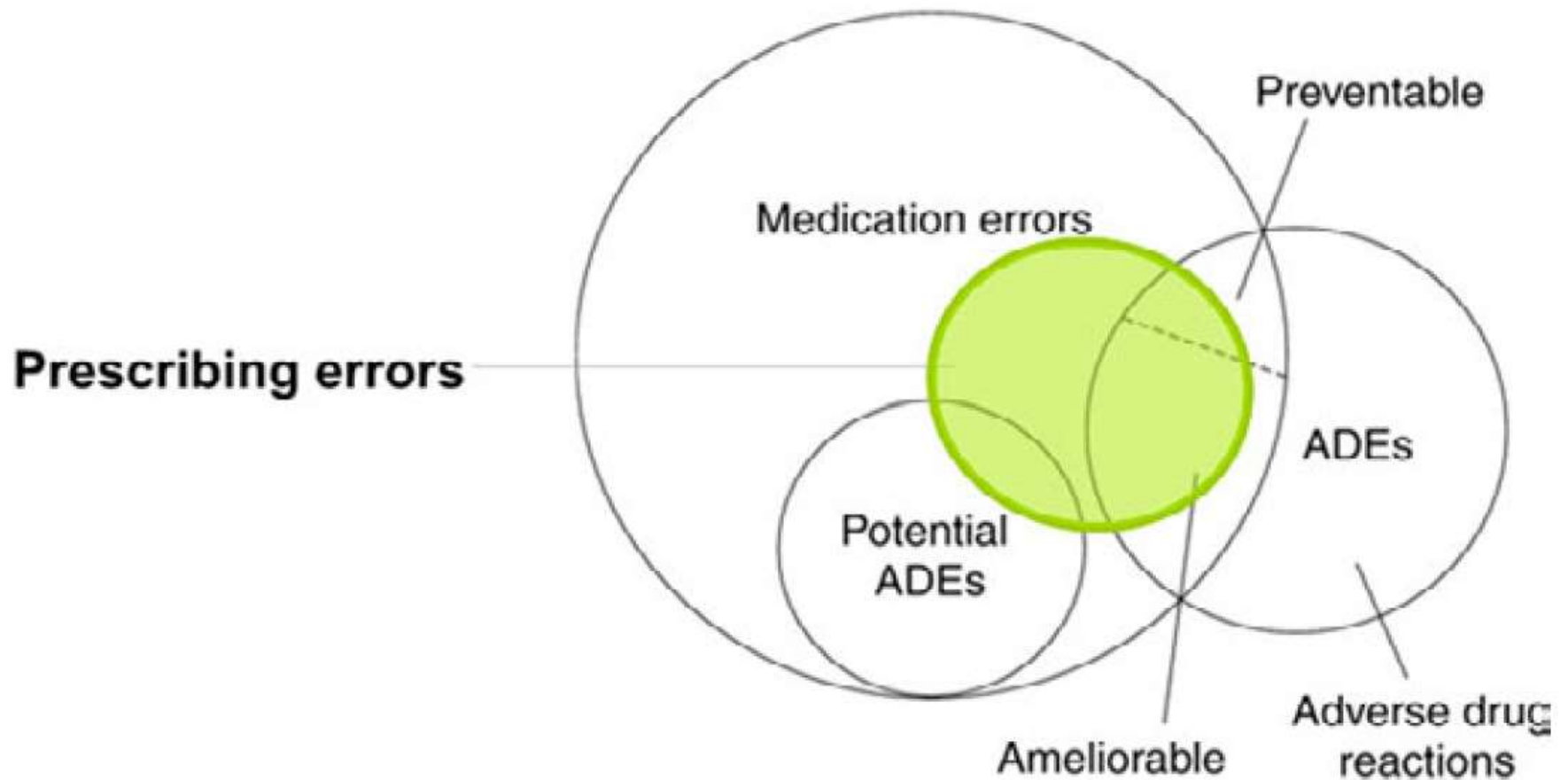


## Reduction in medication errors in hospitals due to adoption of computerized provider order entry systems

	Point estimate(%)	Estimate bound (%)
Mean % reduction in medication errors on using CPOE	-48 %	-55 to -41 %
Proportion of Medication orders made using CPOE	26.1 %	16 to 53.6 %
& reduction in medication error frequency resulting from using CPOE	-12.5	-14.4 to -10.6 %
Absolute reduction in medication errors frequency resulting from using CPOE	17.4 m	0.08 to 27.1 m



**Figure 1** Estimated medication errors averted due to observed and increased use of computerized provider order entry in inpatient acute-care hospitals in a 1-year period.



**Figure 2.** Relationship between adverse drug events (ADEs), potential ADEs, medication errors and prescribing errors (modified from Morimoto<sup>63</sup> p. 307).



# Leapfrog CPOE Standard

- \* Leapfrog Group: a voluntary programme where large employers and public agencies raise awareness of and reward high-quality providers for accomplishing improvements (big leaps) in patient safety
- \* CPOE recommended as one of 3 big leaps in 2000
- \* The Leapfrog Group CPOE Standard:
  - \* Physicians enter at least 75% of medication orders via a computer system that includes prescriber-error prevention software.
  - \* Demonstrate that their inpatient CPOE System can alert physicians of at least 50% of the common, serious prescribing errors using a testing protocol now under development by First Consulting Group



# Leapfrog CPOE Evaluation Tool

- \* A protocol for testing whether a CPOE system with CDS can intercept a variety of potentially dangerous medication orders in a various simulated clinical scenarios
- \* A test bank of over 130 adult test orders developed by an expert panel

# Relationship between medication event rates and the Leapfrog CPOE evaluation tool

*Leung AA, et al. J Am Med Inform Assoc 2013; 20:e85-e90*

- \* For every 5% increase in Leapfrog scores:
  - \* Primary outcome of preventable ADE
    - \* Relative reduction 43% (CI 12-63%)
    - \* Absolute reduction 4.2% (CI 1.1-7.4)
    - \* 4 fewer per 100 admissions

# The impact of computerized physician medication order entry in hospitalized patients – A systemic review

- \* Adherence to guideline or to computerized recommendation increased
- \* Prescribing errors decreased although there are some negative (observational) studies recently. There is no evidence on the effect on ADEs.
- \* Studies on cost and effectiveness showed mixed results. In addition, some important costs may not be accounted for.
- \* Quantitative studies show high adherence to alerts. However qualitative studies show many overridden alerts. Acceptance rate increase with the clinical importance of the alerts.
- \* Direct order entry time increase. When indirect time is measured the overall time did not change, or even decreased.

# Bottom Line

- \* Standardized, structured and legible orders
- \* Potential mainly realized when integrated with
  - \* other clinical systems/applications
  - \* clinical decision support
  - \* judicious use of alert to avoid fatigue

# CPOE in the Hospital Authority

- \* In the HA CMS, the Generic Clinical Request System (GCRS) has been developed for ordering laboratory & radiology tests and simple clinical procedures.
- \* Medication Order Entry (MOE) has been implemented in the outpatient setting for many years
- \* Inpatient Medication Order Entry (IPMOE)
  - \* Development started 2009
  - \* Pilot at Princess Margaret Hospital 2013
  - \* Fully implemented at Tseung Kwan O Hospital and Prince of Wales Hospital
  - \* To be implemented at all acute HA hospitals in the next 4 years

# IPMOE in HA

- \* Developed in-house and in-vivo as a module in HA's Clinical Management System
- \* Loop of prescription, dispensing and administration closed
  - \* Prescription: doctors' digital signatures incorporating government recognized Hong Kong Post E-Cert scheme
  - \* Dispensing: integration with pharmacy dispensing system
  - \* Administration: use of mobile devices with WiFi and Bluetooth connection
- \* Integration with and into typical workflow on wards
- \* Extensive clinical decision support features
- \* System generated print medication administration forms in case of contingency

## Before IPMOE

## Doctors prescribe on MAR



## MAR sent to Pharmacy by porter or fax



## Pharmacists enter prescriptions into electronic system

**Pharmacists check the order and dispense drugs to ward**



- ✓ Nurses check MAR to schedule administration
- ✓ Nurses perform 3-checks-5-rights
- ✓ Nurses sign on MAR



Protonix	25mg daily po
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Chloroform	0.395	105	105	5 mg	10/1
	6A	12N	18P	10/1	23/1

Handwritten student information form for a student named RAN. The form includes fields for name, date of birth, gender, and address. The student's name is RAN, date of birth is 19/7, gender is male, and address is 11/105. The form is signed by the student and dated 11/105.



# Top Reasons for Medication Incidents

Prescribing	Wrong Strength/ dosage	30%
	Wrong Patient	14%
	Known Drug Allergy	9%
Dispensing	Wrong Drug	50 %
	Wrong Strength /dosage	20%
	Wrong Patient	10%
Administering	Dose Omission	21%
	Extra Dose	15%
	Wrong Drug	9%

# Workflow of close-loop IPMOE



1. **Doctors** prescribe drug via IPMOE



2. **Nurses** login system as administered nurse & view MAR via IPMOE (allow > 1 nurse)



System helps to sort out drugs due for giving



3. **Nurses** scan bar code on drug bag to verify **right drug at right time**



Patient identity & drugs data transmitted to scanner via Bluetooth



4. **Nurses** scan patient barcode bracelet to verify **right patient** at bed side



**Pharmacists** vet the order & dispense drugs to ward



Administration record can be seen in Pharmacy to facilitate drug refill

Clear drug administration details are documented in the system



# Core Features: Prescription

## 1. Drug search:

- By Drug Name
- By BNF
- Repeat from Patient's history
- Choose from Drug Set

## 2. Common dosage, condition and route suggestions

## 3. Medication decision support checking

- Drug allergy and adverse reaction
- Drug-Drug interaction
- Pregnancy contraindication
- HLAB1502
- G6PD deficiency
- Therapeutic duplication

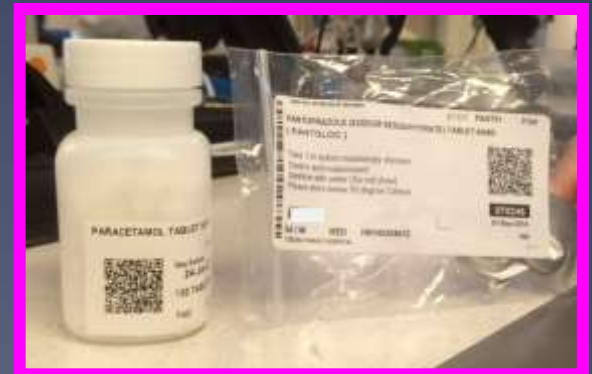
# Core Features: Dispensing

## 1. Dispensing management

- Timely intervention on problem prescription
- Reduce prescription turn-around time

## 2. Label management

- 2D code label on all individual patient dispensing items
- 2D code label for ward stock items which are high risk medications or pre-packed items



# Core Features: Administration

- \* System generated schedule of administration

- \* Barcode scanning for
  - \* patient and drug identification,
  - \* right time and right route



- \* Reminding of outstanding /follow up tasks via clinical dashboard

- \* Dispensing request: urgent/ replenishment



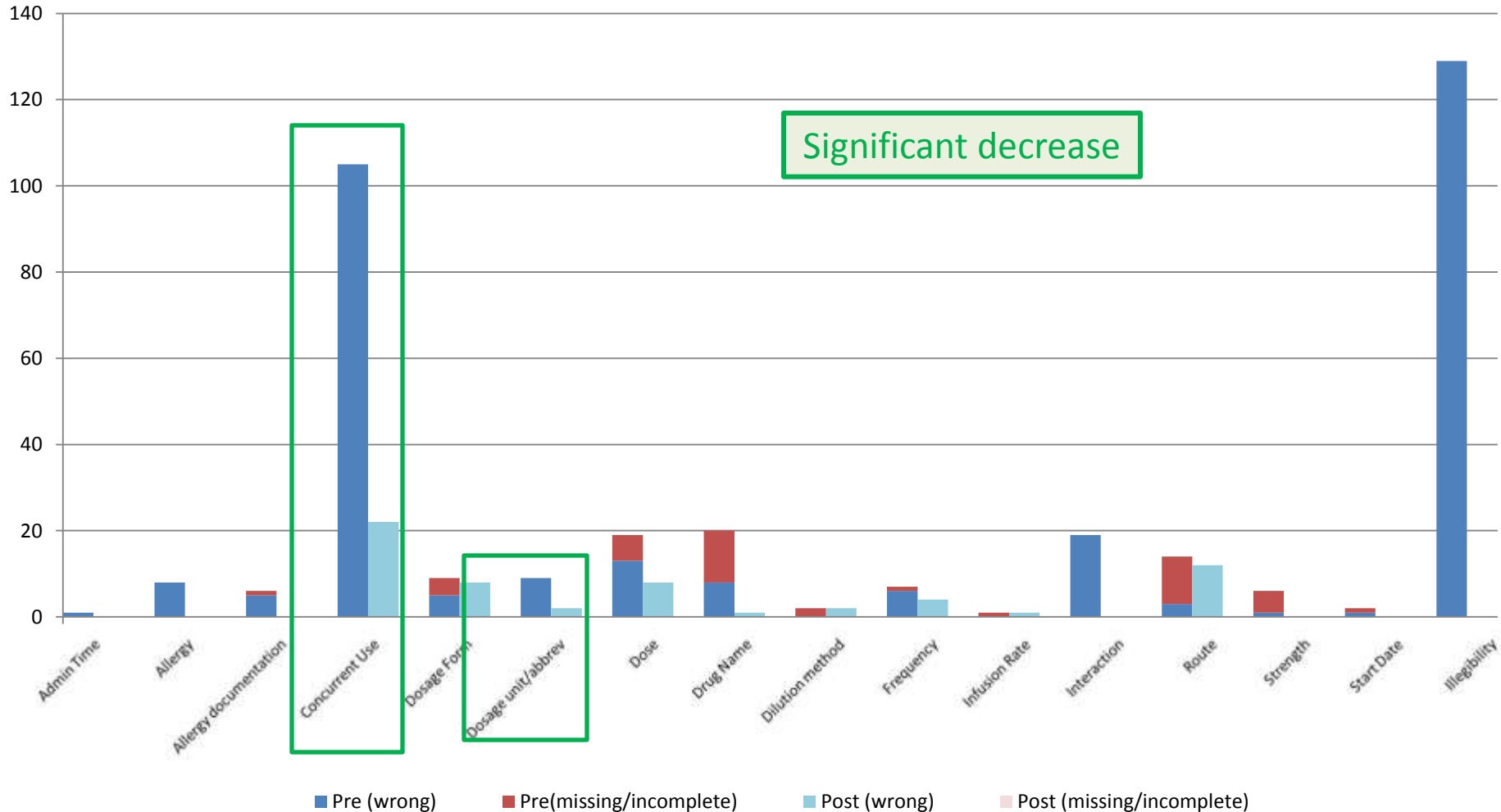
# Benefits

- \* Reduce Medication Error
- \* Improve efficiency
- \* Streamline workflow
- \* Improve communication among caregivers
- \* Improve medication documentation



# Impact of IPMOE

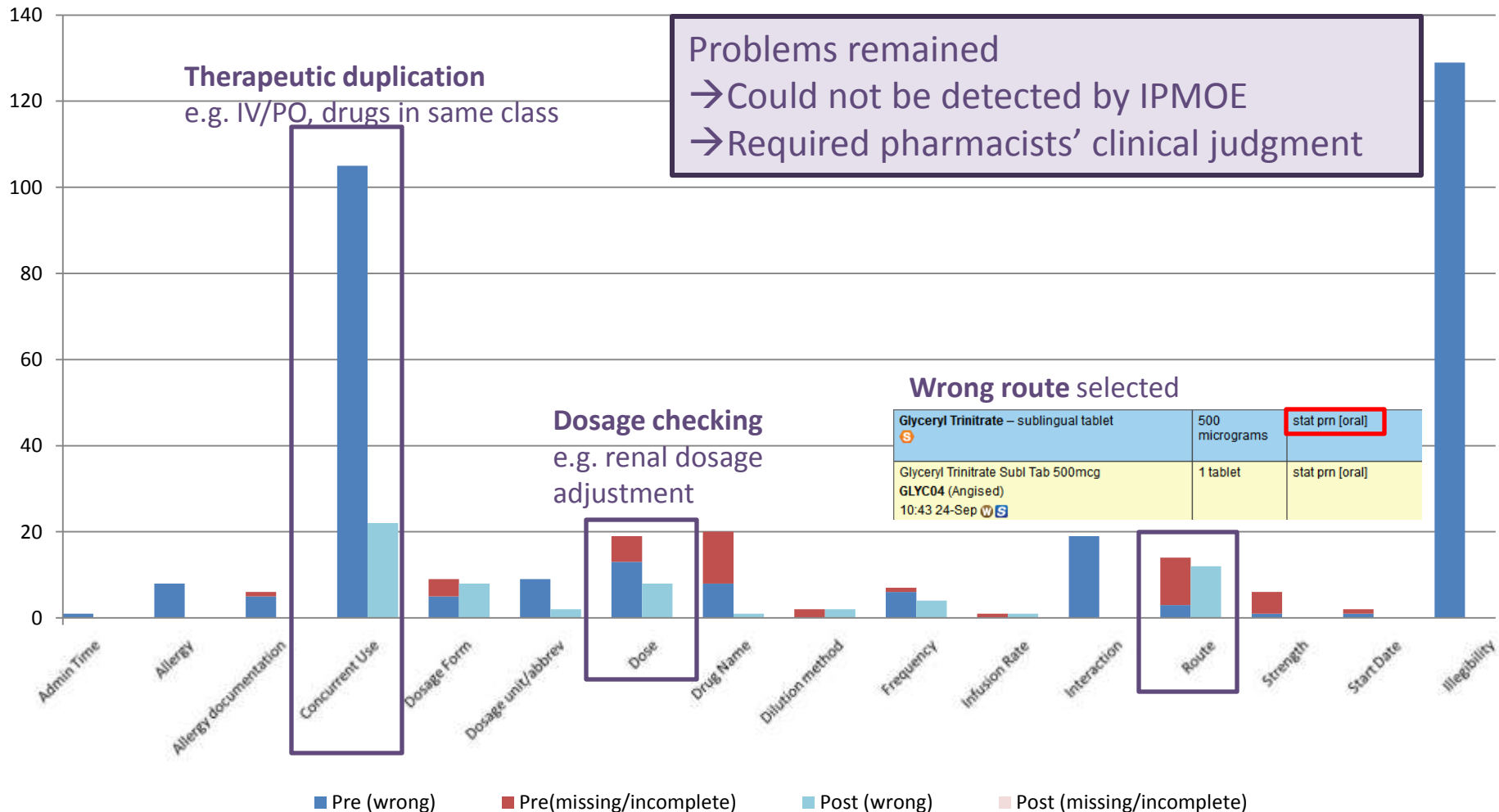
Prescribing error pre and post-implementation





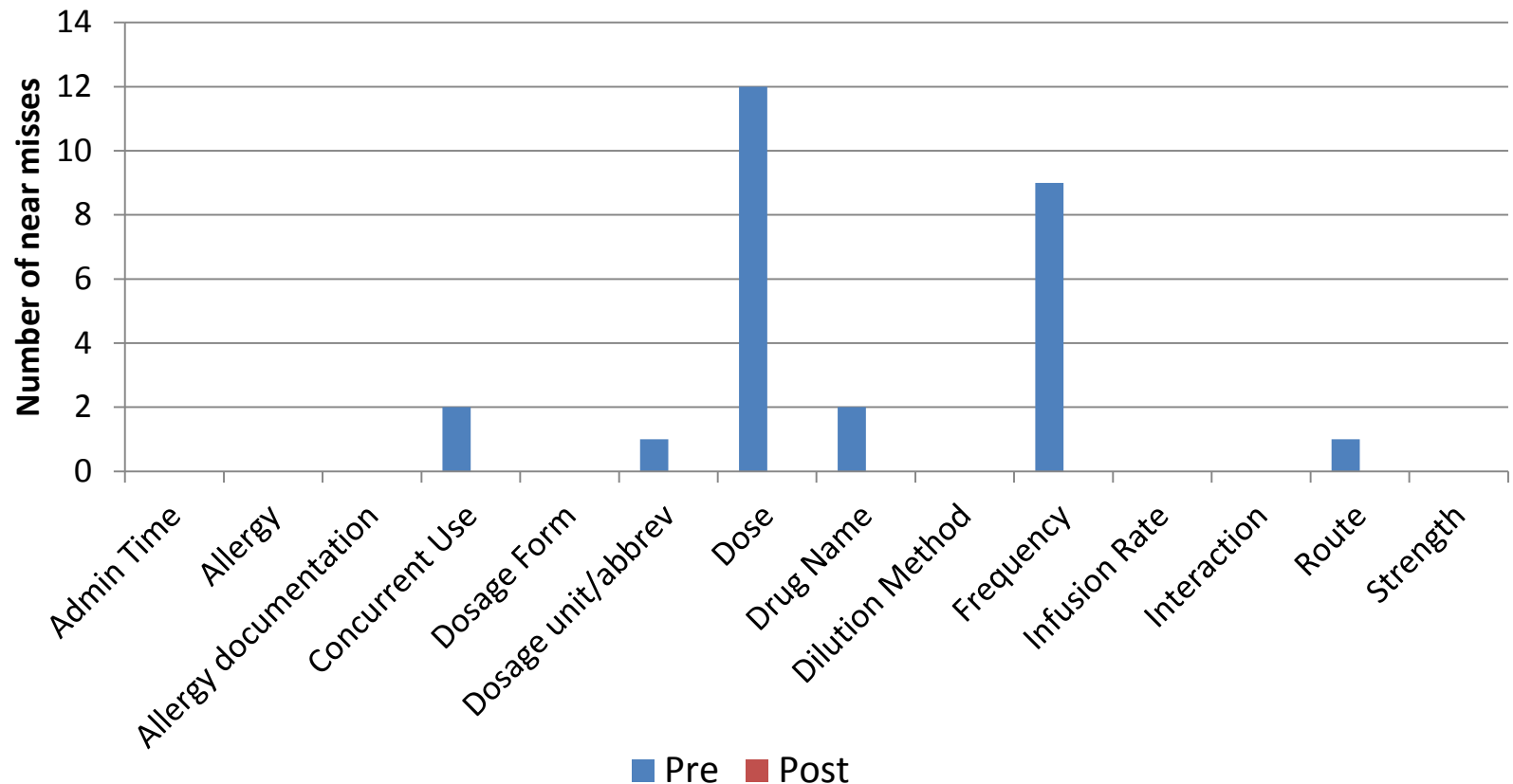
# Impact of IPMOE

## Prescribing error pre and post-implementation



# Impact of IPMOE

Transcribing error pre and post-implementation



# Residual/emerging risks

- \* Dependency on system for operation
  - \* Contingency plans for scheduled and unscheduled down time
- \* Bugs in the system
- \* Risks arising from new workflow and unfamiliarity with system features
  - \* Omission of insulin injection when prescribed prn instead of regular with conditional omission
- \* System only as good as it is designed
  - \* E.g. will not catch wrong dose
- \* Remote prescription

# IPMOE

- \* IT is a game changer in healthcare as in all realms of life
- \* Effectiveness difficult, if not totally impossible, to prove with traditional evidence based medicine methodologies
- \* CDSS with appropriate alerts
- \* System design and features key to effectiveness and efficacy
- \* Engagement, reengineering of workflow & processes and implementation have great impact on successful adoption
- \* Continual update based on user experience and in line with hardware & software development will lead to continual improvement