



GUIDANCE FOR LEAPFROG HOSPITAL SURVEY PARTICIPATING HOSPITALS CLINICAL DECISION SUPPORT RELATED TO THE CPOE EVALUATION TOOL



INTRODUCTION

To fully meet Leapfrog's [Computerized Physician Order Entry \(CPOE\) Standard](#), each adult and general hospital must (1) ensure that licensed prescribers enter at least 85% of inpatient medication orders via a computer system that includes decision support software to reduce prescribing errors, and (2) demonstrate, via a test, that its inpatient CPOE system can alert physicians to at least 60% of frequent serious medication errors known to cause harm to patients. Hospitals are asked to use Leapfrog's CPOE Evaluation Tool to complete an Adult Inpatient Test to fulfill the second requirement of our standard.

Upon successful completion of an Adult Inpatient Test, a hospital's responses are immediately scored and available to be viewed and printed. Results from the test are also archived and can be accessed anytime by logging back into the CPOE Evaluation Tool from the Survey Dashboard.

DESCRIPTION OF THE CPOE EVALUATION TOOL

The CPOE Evaluation Tool was designed by medication safety experts and researchers at Brigham and Women's Hospital and the University of Utah to test the ability of inpatient CPOE systems to alert licensed prescribers to frequent serious medication errors known to cause harm to patients. In addition, the Tool was designed to help hospitals improve on their use of clinical decision support to reduce adverse drug events and improve medication safety. The Tool was first included in the Leapfrog Hospital Survey in 2008. This is the fifth release of the tool (version 3.6).

The CPOE Evaluation Tool includes both a Sample Test and an Adult Inpatient Test. All hospitals are urged to complete the Sample Test prior to the Adult Inpatient Test. Only a hospital's score on the Adult Inpatient Test is used to determine their overall performance on Leapfrog's CPOE Standard.

The timed Test provides users with a set of Test Patients, along with a corresponding set of Test Orders, that users enter into their hospital's CPOE and related clinical systems. The physician conducting the Test records the advice or information they received, if any, from their hospital's CPOE system onto the Orders and Observation Sheet, and then completes the Online Answer Form. Users receive immediate scoring and feedback summarizing the results of the Test. The Tool includes twelve Order Checking Categories including drug-drug interaction, drug-allergy, therapeutic duplications, single and daily dose limits, and others. More information about the Order Checking Categories included in the CPOE Evaluation Tool is available in the [CPOE Evaluation Tool Instructions](#).

ORDER CHECKING CATEGORIES

Each category included in the CPOE Evaluation Tool represents an area where a serious adverse drug event (ADE) could occur if the CPOE system's clinical decision support fails to alert the prescriber. The intent of the test is to measure and improve hospitals' use of clinical decision support to reduce ADEs and improve medication safety. The CPOE Evaluation Tool is designed to test for two types of clinical decision support:

1. **Scenario-Specific Advice/Information:** Information related to the Test Order, which may include the medication's specific dose, route, and frequency, and the Test Patient, which includes specific patient



demographics (e.g., age, gender) and clinical information such as problems/diagnoses, lab values, and allergies, as applicable. The scenario-specific advice/information may also involve the *combination* of two specific medication orders.

2. **Medication-Specific Advice/Information:** General information that might appear any time the medication is ordered for any patient and is not specifically related to the Test Patient (see the Drug Monitoring Order Checking Category).

The table below includes descriptions of each Order Checking Category included in the CPOE Evaluation Tool, as well as a description, example, and the type of clinical decision support (i.e. scenario-specific or medication-specific advise/information) being tested.

Order Checking Category	Description	Example	Type of Clinical Decision Support
Therapeutic Duplication	Medication combinations overlap therapeutically (same agent or same class)	Using clonazepam and lorazepam together	Scenario-specific advice/information
Drug Dose (Single)	Specified dose of medication exceeds safe range for single dose	Tenfold overdose of digoxin	Scenario-specific advice/information
Drug Dose (Daily)	Specified frequency of administration results in daily dose that exceeds safe range for daily dose	Ordering ibuprofen regular dose every three hours	Scenario-specific advice/information
Drug Allergy	Medication (or medication class) is one for which patient allergy has been documented	Penicillin prescribed for patient with documented penicillin allergy	Scenario-specific advice/information
Drug-Route	Specified route of administration is inappropriate and potentially harmful	Use of hydroxyzine intravenously	Scenario-specific advice/information
Drug-Drug Interaction	Medications in pair of orders result in known harmful interaction when used in combination	Concurrent sumatriptan and phenelzine	Scenario-specific advice/information
Drug Diagnosis	Medication dose inappropriate/contraindicated based on documented problem/diagnosis	Nonspecific beta-blocker in patient with asthma	Scenario-specific advice/information
Drug- Age	Medication dose inappropriate/contraindicated based on patient age	Prescribing diazepam for a patient over 65 years old	Scenario-specific advice/information
Drug Laboratory	Medication dose inappropriate/contraindicated based on documented laboratory test results (includes renal status)	Use of nitrofurantoin in patient with severe renal failure	Scenario-specific advice/information
Drug Monitoring	Medication for which the standard of care includes subsequent monitoring of the drug level or lab value to avoid harm	Prompt to monitor drug levels when ordering aminoglycosides or	Medication-specific advice/information



Order Checking Category	Description	Example	Type of Clinical Decision Support
		INR/PT when ordering warfarin	

The Tool also includes an “Alert Fatigue” test category, which checks if prescribers are receiving alerts or information for inconsequential medication interactions that clinicians typically ignore. An example would be alerting on the concurrent use of hydrochlorothiazide and captopril. This test category is not included in scoring.

The Tool also includes a “Deception Analysis” test category, which checks for “false positives” (e.g., orders that should not have generated any warning in the hospital’s CPOE system). Hospital’s that “fail” the Deception Analysis are scored as “incomplete evaluation” and will not be able to retake an Adult Inpatient Test for 120 days.



GENERAL GUIDANCE

HARD STOPS VS. DISRUPTIVE ALERTS

Both hard stops and disruptive alerts can be effective ways to prevent potentially unsafe orders. For example, an unsafe order could be prevented by either:

- Not being able to electronically enter a medication order via an unsafe or inappropriate route
- Receiving a disruptive alert about a selected route being unsafe or inappropriate

The CPOE Evaluation Tool developers recommend a “hard stop” when a medication order is absolutely contraindicated because a “hard stop” prevents the licensed prescriber from entering the unsafe order and prevents manual overrides. However, “hard stops” should be used judiciously and infrequently as there are very few contraindications that warrant a hard stop. Some examples include:

- Drug-Drug Interactions (DDIs) where there is no benefit of the drug combination that outweighs the risk (i.e. Monoamine Oxidase Inhibitors and Sumatriptan).
- Vincristine given intrathecally should be a hard stop since there have been multiple cases of this resulting in death or serious harm.

Other contraindicated DDIs do not warrant a hard stop. For example, Sildenafil and Nitroglycerin should trigger an alert, but would not warrant a hard stop.

GUIDANCE FOR SPECIFIC ORDER CHECKING CATEGORIES

DRUG-DRUG INTERACTION¹⁻⁷

Drug-Drug Interaction (DDI) Severity **level 1** are drug combinations that are contraindicated for concurrent use. These DDIs have a high potential for patient harm where the risk definitely outweighs the benefit.

Some examples of Level 1 DDI include:

- Concurrent use of Simvastatin and Verapamil may result in increased exposure to Simvastatin and an increased risk of myopathy or rhabdomyolysis.
- Concurrent use of Tizanidine and Ciprofloxacin may result in increased Tizanidine plasma concentrations resulting in increased hypotensive and sedative effects.
- Concurrent use of Monoamine Oxidase Inhibitors and Sumatriptan may result in increased risk of serotonin syndrome (hypertension, hyperthermia, myoclonus, mental status changes).

DDI Severity **level 2** are severe adverse interactions where action by a licensed prescriber is required to reduce the risk to the patient. These actions may include monitoring drug levels and/or making dose adjustments as needed. The examples listed are level 2 DDIs that Bates, et al. found to cause patient harm or had the potential to cause harm because appropriate prescriber action was not taken.⁷



Some examples of Level 2 DDI include:

- Concurrent use of Levofloxacin and Warfarin may result in an increased risk of bleeding. Concomitant use has been associated with increases in INR or prothrombin time and clinical episodes of bleeding. If concomitant use is required, early and more frequent monitoring of the patient's INR is recommended.
- Bactrim DS (sulfamethoxazole 800 mg and trimethoprim 160 mg) and Warfarin sodium
 - Concurrent use of Sulfamethoxazole and Warfarin may result in increased warfarin exposure.
 - If co-administration is required, monitor prothrombin time and INR early and closely, especially during initiation. Discontinuation of SMX is recommended. Preemptive warfarin dose reductions may be considered to prevent INR prolongation during co-administration.
- Drugs that both cause QT prolongation (see <http://www.torsades.org> for list of known risk drugs)
 - Haloperidol and Citalopram or Haloperidol and Ondansetron
 - Concurrent use of Haloperidol and Citalopram or Haloperidol and Ondansetron may result in prolonged QTc interval or torsades de pointes. Recommend avoiding concurrent use, but if co-therapy is warranted, recommend monitoring QTc closely.
 - Levofloxacin and Amiodarone
 - Concurrent use of Levofloxacin and Amiodarone may result in an increased risk of cardiotoxicity (QT prolongation, torsades de pointes, cardiac arrest).
 - Citalopram and Omeprazole
 - Concurrent use of Citalopram and Omeprazole may result in increased citalopram exposure and risk of QT interval prolongation. If co-administration of citalopram with omeprazole is required, do not exceed citalopram doses of 20 mg/day and discontinue citalopram in patients who have persistent QTc measurements greater than 500 milliseconds.

DRUG-DIAGNOSIS

Drug Diagnosis alerts should occur when drug combinations are contraindicated based on a patient's documented problem or diagnosis.

- Focus on drugs to avoid in patients with:
 - GI bleeds – avoid Ketorolac
 - Black Box warning: Contraindicated in active or history of peptic ulcer disease, recent gastrointestinal bleeding or perforation, or history of gastrointestinal bleeding
 - Stroke – avoid Prasugrel
 - Black Box warning : Prasugrel can cause significant and sometimes fatal bleeding. Do not use Prasugrel in patients with active pathological bleeding or a history of transient ischemic attack or stroke
 - Asthma – avoid Propranolol , Carvedilol
 - Non-cardioselective beta-blockers were associated with a significantly increased risk of moderate asthma exacerbations when initiated at low to moderate doses and both moderate and severe exacerbations when prescribed chronically at high dose (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5270217/>).
 - Liver disease and use of hepatotoxic drugs



DRUG-AGE^{8–11}

Drug-Age alerts should occur when the drug is contraindicated based on a patient's age. The CPOE Evaluation Tool focuses on drugs that are contraindicated for geriatric patients in particular (and not pediatric patients). There are two important resources that hospitals should consult to ensure their clinical decision support alerts their prescribers to these unsafe scenarios, including:

- 2019 American Geriatrics Society Beers Criteria for Potentially Inappropriate Medication Use in Older Adults.⁸ Hospitals should focus on those recommendations where quality of evidence and strength of recommendation is high, which includes the following:
 - Dronedarone – Avoid in individuals with permanent atrial fibrillation or severe or recently decompensated heart failure
 - Nifedipine, immediate release – Avoid
 - Amiodarone – Avoid amiodarone as first-line therapy for atrial fibrillation unless patient has heart failure or substantial left ventricular hypertrophy
 - Antidepressants, alone or in combination (Amitriptyline, Amoxapine, Clomipramine, Desipramine, Doxepin >6 mg/d, Imipramine, Nortriptyline, Paroxetine, Protriptyline, Trimipramine) – Avoid
 - Barbiturates (Amobarbital, Butobarbital, Butalbital, Mephobarbital, Pentobarbital, Phenobarbital, Secobarbital) – Avoid
 - Ergoloid mesylates (dehydrogenated ergot alkaloids, Isoxsuprine) – Avoid
 - Growth hormone – Avoid, except as hormone replacement after pituitary gland removal
 - Sulfonylureas, long-duration (Chlorpropamide) – Avoid
 - Proton-pump inhibitors – Avoid scheduled use for >8 weeks unless for high-risk patients (e.g., oral corticosteroids or chronic NSAID use), erosive esophagitis, Barrett's esophagitis, pathological hypersecretory condition, or demonstrated need for maintenance treatment (e.g., due to failure of drug discontinuation trial or H2 blockers)
- Screening Tool of Older Persons' Prescriptions (STOPP) version 2.⁹
 - Potentially inappropriate medications listed in STOPP criteria, like some of those listed in Beers criteria, are significantly associated with avoidable ADEs in older people that cause or contribute to urgent hospitalization.¹⁰
 - Use of benzodiazepines, opiates or neuroleptics that lead to falls
 - Use of NSAID that lead to gastritis /peptic ulcer disease
 - Use of diuretics that lead to acute kidney injury and symptomatic orthostasis

Hospitals should also focus on drugs that are known to induce a patient's risk of falling such as: Antihypertensive agents, Diuretics, Sedatives and hypnotics, Neuroleptics and antipsychotics, Benzodiazepines, Narcotics.¹¹

STOPP criteria and Beers criteria have several areas of overlap. Both sets of criteria emphasize the higher risk of adverse drug reactions and events in older people with use of long-acting benzodiazepines, tricyclic antidepressants, anticholinergic drugs, and non-cyclooxygenase 2-selective nonsteroidal anti-inflammatory drugs.¹⁰



DRUG-LABORATORY AND DRUG MONITORING¹²

Drug-Laboratory alerts should occur when drug combinations are contraindicated based on documented laboratory test results, which includes renal status. Some examples of contraindicated combinations include:

- Ordering Potassium Chloride (KCL) or a potassium sparing diuretic (Spironolactone) in a patient with a high Potassium level
- Ordering Digoxin in a patient with a high Digoxin level
- Ordering nephrotoxic and/or renally cleared medications in a patient with a high Creatinine level

Drug Monitoring alerts should occur for drug combinations where the standard of care includes subsequent monitoring of the drug level or lab value to avoid harm. Hospitals should focus on drugs with a narrow therapeutic range, such as aminoglycosides, carbamazepine, digoxin, lithium, phenytoin, phenobarbital, theophylline, and warfarin. Hospitals should ensure that when ordering these medications, their systems directly alert the licensed prescriber at the point of ordering or provide a laboratory order to monitor the patient's potassium levels, creatinine level, INR, and therapeutic drug levels.¹²

THERAPEUTIC DUPLICATION

Therapeutic Duplication alerts should occur when drug combinations overlap therapeutically (same agent or same class).

- Therapeutic Duplication alerts should fire on drugs within the same drug class, such as:
 - 2 Ace Inhibitors – Captopril and Lisinopril
 - 2 Statins – Atorvastatin and Simvastatin
 - 2 NSAID – Ibuprofen and Naprosyn
 - 2 Benzodiazepine – Diazepam and Alprazolam
 - Some drug classes are much more important than others; avoid those with evidence supporting e.g. ACE and ARB
- Therapeutic Duplication alerts should fire on brand and generic name of the same drug
 - Ibuprofen and Motrin

DRUG-DOSE

Drug-Dose alerts should occur when the specified dose or frequency of a medication or administration exceeds the safe range for a single dose or daily dose.

Hospitals should focus on drugs with a narrow therapeutic range, such as digoxin, as well as drugs that can cause serious or immediate toxicity if given in excessive amounts, such as narcotics and benzos. Hospitals should consult the [Institute for Safe Medication Practices High-Alert Medications](#) to ensure their clinical decision support alerts their prescribers to drugs that are known to cause harm if given in excessive doses, including:

- Hypoglycemic agents
- Anticoagulants
- Neuromuscular blockers



- Narcotics / Opioids

DRUG-ALLERGY¹³⁻¹⁵

Drug-Allergy alerts should occur when a drug is contraindicated based on a patient's documented allergy. For example, a Drug-Allergy alert should occur when the patient has a documented allergy to Penicillin (particularly when the reaction is Anaphylaxis) and is ordered a medication that has the potential to cause a severe reaction. Penicillin Drug-Allergy alerts should occur if a 1st generation cephalosporin is being ordered for a patient with a documented Anaphylaxis reaction to Penicillin. We would not expect licensed prescribers to receive penicillin drug-allergy alerts for the later generation cephalosporins. For hospitals focused on improving their antibiotic stewardship practices, it is recommended that patients, who report a penicillin allergy with a documented anaphylaxis reaction, be sent for skin testing to determine if they have a true allergic reaction if a penicillin or a 1st or 2nd generation cephalosporin is the preferred medication for the patient.

Allergy to Opioids¹³⁻¹⁵

Patient reports of opioid "allergies" are common, most often due to symptoms of nausea, vomiting, itching, hypotension, or constipation. Many healthcare providers struggle with distinguishing true allergic reactions from these reported adverse effects/intolerances. Generally, allergies to one opioid agent does not mean the patient is allergic to other opioids so switching to an agent in another opioid chemical class (see list below) may be effective. For example, a patient who is "allergic" to an opioid from one class (e.g., morphine, a phenanthrene) may be treated with an agent from another class (e.g., methadone, a phenylheptane) without cross-sensitivity. Even though the risk of cross-sensitivity is extremely low, patients who exhibit a true allergic reaction to one of the opioid analgesics should be monitored carefully if an agent from another class is substituted. Hospitals should focus on Opioid drug allergy alerts when the reaction is unknown, not documented or a true allergic reaction. We do not expect hospitals to have opioid drug allergy alerts where the reactions are intolerances such as GI upset, nausea, constipation, etc.).

Chemical Classes of Opioid Medications

Phenanthrenes

Codeine
Hydrocodone
Hydromorphone
Levorphanol
Morphine
Oxycodone

Diphenyleptanes

Methadone
Propoxyphene

Phenylpiperidine

Fentanyl
Meperidine

Other- Tramadol



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