THE LEAPFROG GROUP
Giant Leaps for Patient Safety

GUIDANCE FOR ADULT AND GENERAL HOSPITALS PARTICIPATING IN THE 2023 LEAPFROG HOSPITAL SURVEY **CLINICAL DECISION SUPPORT RELATED TO THE 2023 CPOE EVALUATION TOOL**

INTRODUCTION

To achieve 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. To fulfill the second requirement of our standard, hospitals use Leapfrog's CPOE Evaluation Tool to complete an Adult Inpatient Test.

Upon successful completion of an Adult Inpatient Test, a hospital's responses are immediately scored, and results are 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.

SUMMARY OF CHANGES FROM THE 2023 LEAPFROG HOSPITAL SURVEY

The CPOE Evaluation Tool is now available immediately upon submission of the Hospital Profile. This allows adult and general hospitals to complete a CPOE Test at their earliest convenience starting on April 1, without having to first complete and affirm Section 2. CPOE Test results will continue to be scored and publicly reported only once the Survey has been submitted.

Additionally, Leapfrog made several content updates for the Adult Inpatient Test. First, the Test Order library was updated as appropriate based on the latest published literature. Second, the Drug Allergy Order Checking Category was removed due to sustained high performance in this category across all hospitals over multiple years. Finally, the Drug Dose (Single) and Drug Dose (Daily) Order Checking Categories were combined into a single Order Checking Category renamed Excessive Dosing which includes both single and daily dose testing scenarios.

Although the total number of Test Orders has decreased, there are no changes to the scoring algorithm for the Adult Inpatient Test.

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 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. The fifth release of the tool (version 5.0) is available for the 2023 Leapfrog Hospital Survey.

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 prescriber 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 feedback summarizing the results of the Test. The Tool includes ten Order Checking Categories described in the next section.

ORDER CHECKING CATEGORIES

Seven of the eight order checking categories included in the CPOE Evaluation Tool represent 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 eighth order checking category includes Test Orders that, if presented interruptedly, could contribute to over-alerting, which has been shown to contribute to alert fatigue and physician burnout.

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 and lab values, 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 examples and the type of clinical decision support (i.e., scenario-specific advice/information or medication-specific advice/information) being tested.

Order Checking Category	Description	Example	Type of Clinical Decision Support
Inappropriate Medication Combinations	Medication combinations to avoid ordering together or ones to use with caution	Using clonazepam and lorazepam together	Scenario-specific advice/information
Excessive Dosing	Specified dose of medication or frequency of administration exceeds safe range for single or daily dose.	Tenfold overdose of digoxin	Scenario-specific advice/information

Order Checking Category	Description	Example	Type of Clinical Decision Support
Drug Route	Specified route of administration is inappropriate and potentially harmful	Use of hydroxyzine intravenously	Scenario-specific advice/information
Drug Diagnosis	Medication is inappropriate/contraindicated based on documented problem/diagnosis	Non-selective 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 or ordering digoxin for a patient with hypokalemia	Scenario-specific advice/information
Drug Monitoring	Medication for which the standard of care includes subsequent monitoring of the drug level or lab value including baseline labs to avoid harm	Prompt to monitor drug levels when ordering aminoglycosides or INR/PT when ordering warfarin or checking baseline LFTs when starting a statin	Medication-specification advice/information
Excessive Alerts	Low-priority medication combinations, such as drug interactions or therapeutic duplications, that should not trigger decision support warnings.	Concurrent use of hydrochlorothiazide and captopril	Scenario-specific advice/information

If a prescriber reported receiving advice/information for the Test Orders in the Excessive Alerts category or reports not receiving advice/information for the Test Orders that are fatal, these Test Orders are listed in the CPOE Results.

The Adult Inpatient Test also includes a “Deception Analysis,” which checks for “false positives” (e.g., hospitals reporting advice/information for Test Orders that should not generate any warning in the hospital’s CPOE system). Hospitals 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 in preventing potentially unsafe orders from reaching the patient.

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:

- Inappropriate Medication Combinations where there is no benefit of the drug combination that outweighs the risk (i.e., Monoamine Oxidase Inhibitors and Sumatriptan).
- Drug Route combinations where there has been documented harm or death (i.e., Vincristine given intrathecally).

Other Inappropriate Medication Combinations might not warrant a hard stop. For example, Bactrim and warfarin should trigger an alert, but would not warrant a hard stop.

GUIDANCE FOR SPECIFIC ORDER CHECKING CATEGORIES

INAPPROPRIATE MEDICATION COMBINATIONS[1–7]

Inappropriate Medication Combination alerts should appear when prescribers order medications that should not be ordered together, or when prescribers order medications together that require caution. The CPOE Evaluation Tool tests for two specific types of inappropriate medication combination alerts: Drug-Drug Interactions and Therapeutic Duplication.

Drug Interactions
Level 1 Drug Interactions are drug combinations that are contraindicated for concurrent use. These Drug Interactions have a high potential for patient harm where the risk outweighs the benefit.

Examples of Level 1 Drug Interactions include:

- Concurrent use of simvastatin and itraconazole, which may result in increased exposure to Simvastatin and an increased risk of myopathy or rhabdomyolysis.
- Concurrent use of tizanidine and ciprofloxacin, which may result in increased Tizanidine plasma concentrations resulting in increased hypotensive and sedative effects.
- Concurrent use of monoamine oxidase inhibitors and sumatriptan, which may result in increased risk of serotonin syndrome (hypertension, hyperthermia, myoclonus, and mental status changes).

Level 2 Drug Interactions have a high potential for patient harm if action is not taken by a licensed prescriber. These actions may include monitoring drug levels and/or making dose adjustments as needed.

Examples of Level 2 Drug Interactions[7] include:

- Concurrent use of levofloxacin and warfarin
    - 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 Bactrim and warfarin may result in increased warfarin exposure. If co-administration is required, monitor prothrombin time and INR early and closely, especially during

initiation. Preemptive warfarin dose reductions may be considered to prevent INR prolongation during co-administration. The physician may also consider changing the antibiotic that is more appropriate for this patient.

- Drugs that both cause QT prolongation (see http://www.torsades.org for list of known risk drugs)
  - haloperidol and amiodarone[8]
    Concurrent use of either of these drug combinations may result in prolonged QTC interval or torsades de pointes. It is recommended to avoid concurrent use, however if co-therapy is warranted, monitoring QTc closely is recommended.
  - levofloxacin and amiodarone
    - Concurrent use may result in an increased risk of cardiotoxicity (QT prolongation, torsades de pointes, cardiac arrest).
  - citalopram and omeprazole
    - Concurrent use 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.

Therapeutic Duplication
Therapeutic Duplication are drug combinations that overlap therapeutically (same agent or same class).

Examples of Therapeutic Duplication include:
- 2 Ace Inhibitors – captopril and lisinopril
- 2 Statins – atorvastatin and simvastatin
- 2 NSAIDs – ibuprofen and naprosyn
- 2 Benzodiazepines – diazepam and alprazolam
- ibuprofen and Motrin (generic and brand name of the same drug)

DRUG DIAGNOSIS

Drug Diagnosis alerts should occur when the medication that is ordered is contraindicated based on a patient's documented problem or diagnosis.

Examples of Drug Diagnosis contraindications include:
- ketorolac and patients with GI Bleeds
  - Black Box warning: Contraindicated in active or history of peptic ulcer disease, recent gastrointestinal bleeding or perforation, or history of gastrointestinal bleeding
- prasugrel and stroke patients
  - 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
- propranolol and carvedilol and asthma patients
  - Non-cardio selective 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.[9]
- Hepatotoxic drugs and patients with liver disease

DRUG AGE[10–13]

Drug Age alerts should occur when the medication should be avoided based on a patient's age. The CPOE Evaluation Tool focuses on medications that should be avoided for geriatric patients. There are two resources that provide important examples of drug-age contraindications.

- 2019 American Geriatrics Society Beers Criteria for Potentially Inappropriate Medication Use in Older Adults.[10] Hospitals should focus on those recommendations where the quality of evidence and strength of the 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.[11] 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.[12]
    - 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, and narcotics.[13]

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.[12]

DRUG LABORATORY AND DRUG MONITORING[14]

Drug Laboratory alerts should occur when drug combinations are contraindicated based on documented laboratory test results, which includes renal status.

Examples of contraindicated drug lab 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 including baseline labs 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 labs that are needed for that medication. Examples of these include potassium levels, LFTs, creatinine level, INR, and therapeutic drug levels.[14]

EXCESSIVE DOSING

Excessive drug dose alerts should occur when the specified dose or frequency of administration for a medication 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

EXCESSIVE ALERTS

Medication orders in the Excessive Alerts category include low-priority medication combinations that should not trigger decision support warnings. By presenting these orders uninterruptedly, the number of alerts prescribers see is reduced, which can help reduce alert fatigue.

Examples of these inconsequential medication combinations include, but not limited to[6]:

- omeprazole and benzodiazepines
- NSAIDs and thiazide-type diuretics

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