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Improving Medication Safety through Technology-Related Error Classification

The adoption of computerised provider order entry (CPOE) systems in healthcare has brought substantial improvements to medication safety, reducing errors associated with manual prescribing. However, these systems are not without flaws. Technology-related errors (TREs) in CPOE systems can undermine safety efforts, particularly when they disrupt hospital medication ordering processes. Recognising and categorising these errors allows healthcare providers to identify the underlying causes, enabling targeted system improvements. Recent advancements have led to the Technology-Related Error Mechanism (TREM) classification, which offers a structured approach to minimise TREs and enhance patient safety.

The Evolution and Scope of the TREM Classification

Initially developed for adult hospital settings, the TREM classification has evolved to address a broader range of technology-induced prescribing errors. This development involved analysing data from over 1,600 prescribing errors, specifically within paediatric settings, which face unique medication challenges, such as weight-based dosing. The updated classification now comprises seven primary categories with 19 detailed subcategories, each representing distinct mechanisms behind TREs. These categories help identify specific failures within CPOE systems, such as system misconfigurations, issues with patient record selection and errors related to hybrid systems combining both paper and digital processes. By establishing a detailed taxonomy, the TREM classification enables healthcare organisations to identify and address root causes, making CPOE systems safer and more effective across different hospital settings.

Key Categories of Technology-Related Errors

The TREM classification outlines six primary categories of technology-related errors that affect CPOE systems:

1. ***Incorrect System Configuration or System Malfunction Errors*** include issues arising from incorrect system settings or technical faults that interfere with standard workflows;
2. ***Patient Record Access Errors***, where a prescriber unintentionally accesses the wrong patient file, often due to navigation or interface design challenges;
3. ***Selection Errors***, which happen when incorrect options are chosen from system menus, typically due to confusing layouts or poorly set defaults;
4. ***Data Entry Errors*** occur when incorrect information is entered manually, often due to the complexity of input processes;
5. ***Pre-filled Data Errors***, where pre-populated data isn't adjusted appropriately, leading to inaccuracies;
6. ***Workflow Errors*** arise from differences between digital and paper-based workflows, where unfamiliar electronic processes can result in oversights or errors.

Each category reflects a distinct mechanism that can compromise the safety and efficiency of electronic prescribing.

Implementing and Assessing the TREM Classification

Applying the TREM classification involves a structured process where healthcare teams review error records and simulate error-prone scenarios in test environments to establish whether an error is truly technology-induced. In the study supporting the expanded classification, trained reviewers used TREM to assess errors across various types—such as dose miscalculations, timing discrepancies and drug duplications—ensuring that the classification is reliable and broadly applicable. With a strong agreement level between reviewers, the classification demonstrated its capacity to deliver consistent results, making it a robust tool for assessing CPOE errors. Implementing the TREM classification within a healthcare setting allows institutions to evaluate errors not only based on their type but also on their frequency and severity, aiding prioritisation efforts. For example, errors involving high-risk medications, such as opioids or anticoagulants, could be prioritised for immediate system adjustments. Insights from the classification enable system administrators to implement targeted changes, such as refining drop-down menu options, reducing unnecessary default settings or limiting options for high-risk medications to minimise inadvertent selection errors.

The Technology-Related Error Mechanism classification is pivotal in advancing patient safety by systematically addressing technology-induced errors within CPOE systems. By categorising errors based on their underlying mechanisms, the classification empowers healthcare organisations to identify and prioritise areas for improvement, optimising CPOE design for enhanced user efficiency and patient safety. Applying frameworks like the TREM classification will be essential for managing the risks associated with digital health tools. Through ongoing assessment and refinement, this classification aids healthcare providers in proactively addressing TREs, ensuring that CPOE systems fulfil their potential to improve, rather than compromise, the safety of patient care.

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