Duplicate Medication Order Errors:
Safety Gaps and Recommendations for Improvement

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Abstract

Background: Duplicate medication orders are a prominent type of medication error that in some circumstances has increased after implementation of health information technology. Duplicate medication orders are commonly defined as two or more active orders for the same medication or medications within the same therapeutic class. While there have been several studies that have identified contributing factors and described potential solutions, duplicate medication order errors continue to impact patient safety.

Methods: We analyzed 377 reports from 95 healthcare facilities to more granularly define the types of duplicate medication order errors and the context under which these errors occurred, as well as potential contributing factors.

Results: Of the 377 reports reviewed, 304 (80.6%) met the criteria to be defined as a duplicate medication order error. The most frequent duplicate medication order error type was same order (n=131, 43.1%), followed by same therapeutic class (n=98, 32.2%) and same medication (n=70, 23.0%). Errors were identified during different medication process tasks and most commonly during medication reconciliation during the patient's stay in the hospital (n=72, 23.7%) and during pharmacy verification (n=36, 11.8%). Factors contributing to these errors included health information technology issues (n=63, 20.7%), gaps in care coordination (n=44, 14.5%), and a prior dose or medication order not being discontinued (n=52, 17.1%).

Conclusion: Our results highlight specific areas for practice improvement, and we make recommendations for how healthcare facilities can better address duplicate medication order errors.

Keywords*: duplicate medication, medication ordering, human factors, health information technology, patient safety*

Introduction

Electronic health records (EHRs) and computerized provider order entry (CPOE), which is one component of EHRs, have been widely adopted over the last 10 years, with nearly every healthcare facility in the United States using these health information technologies. These technologies provide numerous benefits, including easy access to certain patient information, standardized ordering processes, and guidance for providers through clinical decision support (CDS).[1,2] However, as with many new technologies, unintended consequences can occur, including medication order errors that may lead to patients experiencing adverse outcomes.[3,4]

Duplicate medication orders are one prominent type of medication error that has increased after the implementation of CPOE and other health information technology (health IT) in some contexts.[4-11] For example, a study evaluating medication error and adverse event data found an increase in the frequency of duplicate medication orders after the implementation of CPOE even with duplicate medication alerts, most of which were for identical orders for the same medication.[11] Though there are some nuances, duplicate medication order errors are commonly defined as two or more unintentional active orders for the same medication or medications within the same therapeutic class.[6,11] These errors can occur for a variety of reasons, including medication discontinuation failures, medication database design, and provider ordering practices.[1,4,9,11,12] There has been extensive research on duplicate medication orders that has primarily focused on identifying factors contributing to these errors and identifying potential solutions.

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There are several studies that have quantified the frequency of duplicate medication order errors and there is wide variability in error rates. A study examining medication errors related to CPOE from six healthcare sites in the United States found approximately 11% of errors were duplicate medication orders.[6] One study found an average duplicate medication order error rate of 1.8% (n=5,442 of 316,160) over 84 weeks at a "hospital for special surgery."[4] An observational study involving chart reviews of 94 voided medication order errors found that almost half (n=44, 46.8%) were related to duplicate orders.[5] A subsequent study analyzing voided medication orders within the CPOE system over 16 months found duplicate medication orders to be the most prevalent error type (n=423 of 842, 50.2%), most of which were related to technological risk factors.[13] Using an innovative approach to identify error prevalence, Yang and colleagues[14] developed a CDS engine that can download patients' up-to-date medication history from a national medication repository and web-based query system to support the CPOE system in the detection of potential duplicate medication order errors, and to investigate its impact on clinical encounters by analyzing clinical encounter data. With this approach, they were able to increase the detection rate of duplicate medication order errors from the previously noted rate of 2.4% to 5.83% of total prescriptions.[15]

Several studies have sought to identify contributing factors to duplicate medication order errors. Wetterneck and colleagues[11] used a work system model called the Systems Engineering Initiative for Patient Safety (SEIPS), which is a human factors and systems engineering–based model to identify factors contributing to patient safety hazards, to study duplicate medication order errors. They found 12 factors across the five elements of the work system: technology, tasks, environment, people, and organization.[16] Most factors were related to the CPOE technology and CDS alerts, followed by organizational factors, people, tasks, and environment. Tolley and colleagues[12] identified contributing factors to duplicate medication errors associated with CPOE use in pediatrics. Contributing factors included inappropriate drug duplication alerts and inappropriate system design related to order sets. Looking across studies, commonly identified contributing factors were provider ordering practices, order set functionality where order sets default to preselected medications, CDS and medication database design, difficulty viewing existing medication orders, and medication discontinuation failures leading to duplicate orders.[1,4,5,9,11,12] For provider ordering practices, this includes duplicate medication orders placed by two different providers, which one study stated was more likely to occur than a duplicate medication order error originating from the same provider.[4] For CDS and medication database design, this includes false-positive drug duplication alerts and alerts not generating for drug duplication orders.[11, 12] Studies have also looked at the drugs associated with duplicate medication order errors. One study found the drugs that accounted for most duplications included hydromorphone, acetaminophen, intravenous (IV) ondansetron, and oxycodone-acetaminophen.[4]

Proposed solutions for provider ordering practices include defining roles and improving communication among team members to prevent multiple providers from erroneously entering duplicate medication order errors.[4,11,12] Solutions for CDS and medication database design include customizing and using context-specific alerts, manufacturing databases, and EHR algorithms to identify and check for duplicate or additive medication order errors, and maintaining a pharmacist role for error recovery.[4,11,12] For CPOE data display, medication orders should be made more accessible during the entire medication process (ordering, dispensing, review, administration).[11] Of these solutions, the most commonly proposed across different studies were related to order set functionality and maintaining a pharmacist role.[4,11,12] Common solutions for order set issues include limiting "select all" functionality, removing drugs from order sets, and combining commonly used order sets into one order set to eliminate duplicates.

Despite research identifying contributing factors to duplicate medication order errors and the identification of certain solutions to address some of these errors, duplicate medication order errors persist in practice. We sought to more granularly define the types of duplicate medication order errors and the context under which these errors are occurring. Further, we examined the potential factors contributing to these errors. Our results highlight specific areas for practice improvement, and we make recommendations for how healthcare facilities can better address duplicate medication order errors.

Methods

Data Source and Selection

We analyzed patient safety event reports submitted to the Pennsylvania Patient Safety Reporting System (PA-PSRS*) between January 1 and December 31, 2021.[17] All nonfederal, acute care facilities in Pennsylvania are required to report patient safety events through the PA-PSRS system. As this includes both teaching and nonteaching facilities, the full range of providers, including medical doctors, physician assistants, nurse practitioners, and associated trainees, may have entered medication orders in EHRs. Our analysis focused on reports submitted to the Medication Error event type category by the reporter that contained free text with variations of the following keywords: duplicate, double ordered, same order, order already exists, and repeated order. This method resulted in 1,965 reports; however, 1,230 (62.6%) reports were submitted by one facility. To address the issue of oversampling from a single facility, we randomly selected a maximum of 10 reports from each facility. Based on this criterion, a total of 377 reports from 95 facilities were manually reviewed.

Analysis Methods

A descriptive analysis of mandatory structured fields as reported by healthcare facilities to PA-PSRS included event classification (incident† or serious event‡), facility type, care area type, and

*PA-PSRS is a secure, web-based system through which Pennsylvania hospitals, ambulatory surgical facilities, abortion facilities, and birthing centers submit reports of patient safety–related incidents and serious events in accordance with mandatory reporting laws outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Act 13 of 2002).[17] All reports submitted through PA-PSRS are confidential and no information about individual facilities or providers is made public.

†An incident is defined as "an event, occurrence or situation involving the clinical care of a patient in a medical facility which could have injured the patient but did not either cause an unanticipated injury or require the delivery of additional health care services to the patient."[17]

‡A serious event is defined as "an event, occurrence or situation involving the clinical care of a patient in a medical facility which could have injured the patient but did not either cause an unanticipated injury or require the delivery of additional health care services to the patient."[17]

patient age. The event description and event recommendation free-text fields were qualitatively analyzed using a grounded theory approach.[18] Our coding taxonomy was iteratively developed by two nurses (EF, PS), a physician (SK), and three human factors subject matter experts (JH, LB, TK). We operationally defined a safety report as a duplicate medication order error if the report described a duplicate medication or medication within the same therapeutic class that was ordered unintentionally. Duplicate medications that were ordered intentionally and correctly, for example, a standing order and a pro re nata (PRN, i.e., as needed) order for the same medication for standard pain management, were not included in our analysis.

Reports that met the duplicate medication order error definition above were further reviewed and coded according to the taxonomy developed, which is described in **Tables 1**, **2**, **3**, **5**, and **6** with definitions and examples. First, each report was categorized into one of three duplicate medication order error types (i.e., same order, same therapeutic class, same medication) and the medication(s) involved were noted from the free-text narrative and/or mandatory PA-PSRS medication prescription name field. Medications submitted as a brand name were modified to their generic names for analysis. The reports were then further categorized based on one or more factors that contributed to the duplicate medication order error (e.g., health IT issue, gaps in care coordination), the medication process task in which the error was identified, and the role of the individual who identified the error. Reports were also coded for whether the patient received a duplicate medication in error.

Coding Process. A nurse and a human factors subject matter expert (PS, TK) manually reviewed and coded all reports. The first 100 reports coded were reviewed and discussed by both coders to address discrepancies and develop consensus prior to coding the remainder of the reports. All 377 reports were dually coded. In instances in which the coders did not agree after the first 100 reports, the report was reviewed by another clinician (JR) for final consensus.

Results

Of the 377 reports reviewed, 304 (80.6%) met the criteria to be defined as duplicate medication order errors. Of these 304 reports, nearly all reports were incidents (n=303, 99.7%) and there was one serious event (0.3%). Most reports involved inpatients (n=266, 87.5%), 13 reports involved outpatients (4.3%), and for 25 reports the patient status was unknown (8.2%). The three care areas most frequently reported were the medical/surgical unit (n=56, 18.4%), pharmacy (n=40, 13.2%), and telemetry (n=28, 9.2%). Nearly all reports were associated with adult patients (19 years of age and older) (n=290, 95.4%).

Duplicate Medication Order Error Type and Medications Involved. The most frequent duplicate medication order error type was same order (n=131, 43.1%), followed by same therapeutic class (n=98, 32.2%), same medication (n=70, 23.0%), and insufficient information (n=5, 1.6%). All frequency counts and percentages for duplicate medication order error types, along with definitions and examples, are displayed in **Table 1**. Of the 304 reports, 301 (99.0%) had an associated medication that was identifiable from the report. Of these, the three most frequently reported medications were heparin (n=26 of 301, 8.6%), enoxaparin (n=24 of 301, 8.0%), and apixaban (n=20 of 301, 6.6%).

The data were also analyzed to identify frequent medications mentioned in the report by error type. Of the 131 reports with the error type same order, 130 (of 131, 99.2%) had an associated medication. One report listed the medication involved as "unknown." In these 130 reports, the medications most frequently reported were aspirin (n=9 of 130, 6.9%), vancomycin (n=9 of 130, 6.9%), and insulin (n=8 of 130, 6.2%). All of the 98 reports with the error type same therapeutic class had an associated pair of medications. Of these 98 reports, the three medication pairs most frequently reported were apixaban and heparin (n=10 of 98, 10.2%), apixaban and enoxaparin (n=8 of 98, 8.2%), and enoxaparin and heparin (n=6 of 98, 6.1%). Of the 70 reports with the error type same medication,

Table 1. Frequency Counts, Percentages, Definitions, and Examples of Duplicate Medication Order Error Types, N=304

Category	Frequency Count (%)	Definition	Example*
Same order	131 (43.1%)	The report describes the same medication, dose, and frequency were ordered more than once, resulting in a duplicate medication order error.	The patient had two separate orders for pantoprazole 40 mg daily. The orders were verified by two different pharmacists.
Same therapeutic class	98 (32.2%)	The report describes medications within the same therapeutic class were ordered more than once, resulting in a duplicate medication order error.	The patient was ordered both enoxaparin and apixaban on admission.
Same medication	70 (23.0%)	The report describes the same medication was ordered more than once but frequency, dose, or route was different, resulting in a duplicate medication order error.	The patient was ordered Tylenol 1000 mg IV every six hours and Tylenol 975 mg PO (by mouth) every six hours.
Insufficient information	5 (1.6%)	The report describes a duplicate medication order error but does not specify the specific type of error. It is clear from the report that the error is a duplicate medication order error but does not provide sufficient context to further categorize the error.	Duplicate medications given—the patient received two doses.

*Details of the PA-PSRS event narratives described in the Example column have been modified for readability and to preserve confidentiality.

69 reports (98.6%) had an associated medication. One report listed the medication involved as "multiple medications." The three medications most frequently reported were acetaminophen (n=6 of 69, 8.7%), pantoprazole (n=5 of 69, 7.2%), and vancomycin (n=4 of 69, 5.8%).

Medication Process Tasks in Which the Duplicate Medication Order Error Was Identified. There were no reports of duplicate medication order errors identified during the prescribing/ordering process. Of the 304 error reports, 72 (23.7%) were identified during medication reconciliation during stay, 36 (11.8%) were identified during pharmacy verification, 28 (9.2%) were identified during administration or monitoring, 11 (3.6%) were identified during medication reconciliation on discharge, and 9 (3.0%) were identified during medication reconciliation on admission. There was insufficient information in 148 (48.7%) reports to determine in which medication process task the duplicate medication order error was identified. A breakdown of the medication process tasks in which errors were identified can be found in **Table 2**.

Table 2. Frequency Counts, Percentages, Definitions, and Examples of the Medication Process Tasks in Which the Duplicate Medication Order Error Was Identified, N=304

Category	Frequency Count (%)	Definition	Example*
Prescribing/ ordering	0 (0.0%)	The report describes the duplicate medication order error was identified during the electronic ordering process.	Not applicable.
Pharmacy verification	36 (11.8%)	The report explicitly describes the duplicate medication order error being identified during the standard pharmacy workflow verifying orders after the provider has entered them.	The provider ordered subcutaneous heparin and oral apixaban. The provider overrode the duplicate therapy warning. During pharmacist verification, the pharmacist contacted the provider for clarification on duplicate therapy and correct dosage to align with home dosage. Subcutaneous heparin was discontinued. Oral apixaban was continued at the correct dose.
Administration or monitoring	28 (9.2%)	The report describes the duplicate medication order error was identified during medication administration or monitoring. Administration or monitoring includes retrieval of medications from an automated dispensing cabinet and any final dose preparation that is necessary, as well as actual administration of the medication and subsequent patient monitoring that may be required.	The patient was ordered to restart oral Depakote. The registered nurse called for the first dose and noticed an order for IV valproic acid was still active. Both are valproic acid products. The RN spoke with the intensivist about the duplication. The IV was discontinued after the night dose and oral valproic acid syrup was started, as a patient has a Dobhoff nasogastric tube, and Depakote cannot be crushed.
Medication reconciliation on admission	9 (3.0%)	The report describes the duplicate medication order error was identified during medication reconciliation while the patient was being admitted.	The patient was transferred from another hospital. Admission orders included half of the orders from the admitting hospitalist, and half were rehab orders. There were many duplications.
Medication reconciliation during stay	72 (23.7%)	The report describes the duplicate medication order error was identified during medication reconciliation at some point during the patient's hospital stay.	Upon review of the patient profile, it was noticed that the patient was ordered a duplicate insulin drip. Spoke to the provider to discontinue the duplicate insulin drip.
Medication reconciliation on discharge	11 (3.6%)	The report describes the duplicate medication order error was identified during medication reconciliation in preparation for the patient's discharge.	Upon discharge, the pharmacist noticed a duplicate order for ciprofloxacin on the medication reconciliation. The order was for ciprofloxacin 500 mg and 750 mg. The pharmacist alerted the nurse, who paged the provider to verify the antibiotic order. No harm to patient as the duplicate was caught before discharge and fixed.
Insufficient information	148 (48.7%)	There is insufficient information in the report to determine in what medication process task the duplicate medication order error was identified.	The RN modified the rivaroxaban order and medical record from "with supper" to "BID meals" (twice a day) and the patient received duplicate dosing for three days.

*Details of the PA-PSRS event narratives described in the Example column have been modified for readability and to preserve confidentiality.

Factors Contributing to Duplicate Medication Order Errors. Each report had one or more contributing factors assigned if they could be identified from the report free text, as shown in **Table 3**. Health IT issues were identified in 63 of the 304 reports (20.7%). Of these, an alert being overridden was the most common (n=43 of 63, 68.3%). A prior dose or medication not being discontinued was a contributing factor to 52 (17.1%) reports and gaps in care coordination contributed to 44 (14.5%) reports. For many reports, there was insufficient information to determine the factors contributing to the error (n=171, 56.3%). The contributing factors identified in **Table 3** are not mutually exclusive; more than one contributing factor may have been coded for each report.

Role of the Individual Who Identified the Error. As displayed in **Table 4**, duplicate medication order errors were most frequently caught by a pharmacist (n=111, 36.5%), followed by a nurse (n=58, 19.1%); physician or advanced practice provider (n=4, 1.3%); and patient, lay caregiver, or family member (n=1, 0.3%). There was insufficient information in 130 (42.8%) reports to determine who caught the error.

Whether the Patient Received the Duplicate Medication. The patient erroneously received a duplicate medication in 34.2% (n=104) of the reports analyzed, as shown in **Table 5**. Patients did not receive a duplicate medication in 44.1% (n=134) of reports. There was insufficient information in 21.7% (n=66) of reports such that we could not determine whether the patient erroneously received a duplicate medication.

Table 3. Frequency Counts, Percentages, Definitions, and Examples of Factors Contributing to the Duplicate Medication Order Error, N=304

Category	Frequency Count (%)	Definition	Example*
Prior dose or medication not discontinued	52 (17.1%)	The report explicitly mentions that an existing order for the same medication or a medication within the same therapeutic class was not discontinued when it should have been at the time the duplicate medication order was placed.	The patient had duplicate orders for Neurontin, 400 mg TID (three times a day) and 600 mg TID, as the 400 mg dose was not discontinued when the 600 mg dose was initiated.
Health IT issue: Alert overridden	43 (14.1%)	The report explicitly mentions that a medication alert was fired and manually overridden.	Heparin was infusing. Eliquis 10 mg PO was also ordered and given. There was a duplicate therapy alert that was overridden. The patient was monitored, no patient harm.
Health IT issue: Alert did not fire	11 (3.6%)	The report explicitly mentions that a medication alert did not fire when it should have. This could be due to a malfunction or because an alert was not programmed for that medication.	The patient was ordered nonformulary dexlansoprazole 60 mg daily PO. Pantoprazole was ordered 40 mg IV BID the next day. The patient received three doses of the duplicate PPI (proton pump inhibitors) before it was caught. There was no duplicate interaction checking since dexlansoprazole was ordered as tumor necrosis factor (the medication was ordered for an off-label use).
Health IT issue: Health IT automation contributed to error	9 (3.0%)	The report explicitly mentions that an automated health IT feature (e.g., default settings, prechecked orders) contributed to the duplicate medication order error.	Aspirin 81 mg daily was ordered twice, both verified by the system. It was caught the following day on the autoverification report. The nurse did not administer the duplicate medication.
Gaps in care coordination	44 (14.5%)	The report describes a breakdown in care coordination between multiple providers (two or more) or during any transition of the patient between care areas (e.g., transfer from ED to the floor, discharge to home) at the time the error occurred. A breakdown is defined as any absent, inaccurate, or ambiguous information that contributed to a duplicate medication order error.	The patient was ordered Zofran by orthopedic trauma team. The hospitalist then ordered a duplicate during their portion of the admission process.
Insufficient information	171 (56.3%)	There is insufficient information in the report to identify a factor or factors contributing to the duplicate medication order error being made.	There was a therapeutic duplication of anticoagulation medications (Eliquis and Xarelto) and the patient received both medications.

*Details of the PA-PSRS event narratives described in the Example column have been modified for readability and to preserve confidentiality.

Table 4. Frequency Counts, Percentages, Definitions, and Examples of the Role of the Individual Who Identified the Error, N=304

Category	Frequency Count (%)	Definition	Example*
Pharmacist	111 (36.5%)	The report describes the error being identified by a pharmacist. The error may have been caught with the help of a health IT feature, or it may have been caught by any other means.	Duplicate Lopressor was ordered and verified. It was discovered by evening registered pharmacist (RPh) when verifying a different order. The patient received an extra dose in the morning. The provider was made aware and discontinued the duplicate order.
Nurse	58 (19.1%)	The report describes the error being identified by a nurse. The error may have been caught with the help of a health IT feature, or it may have been caught by any other means.	The patient was ordered Lipitor 40 mg daily. The next day another order for Lipitor 40 mg daily at bedtime was entered and verified. The patient received two doses of 40 mg. Nursing reported the duplication of doses to pharmacy.
Physician or advanced practice provider	4 (1.3%)	The report describes the error being identified by a provider (including attending, fellow, and resident physicians; physician assistants; and nurse practitioners). The error may have been caught with the help of a health IT feature, or it may have been caught by any other means.	The physician assistant called the director of pharmacy and asked her to review the medication administration record for this patient. It was evident that the patient received two doses of 25 mg metoprolol succinate from two orders for metoprolol succinate 25 mg daily.
Patient, lay caregiver, or family member	1 (0.3%)	The report describes the error being identified by a patient, lay caregiver, or family member prior to reaching the patient. The error may have been caught with the help of a health IT feature, or it may have been caught by any other means.	The patient informed the post-anesthesia care unit (PACU) RN she had previously received Rhophylac. The RN returned the injection to the pharmacy. The RPh questioned the PACU and upon review of the patient records found the patient had been given Rhophylac in obstetric triage at her last encounter the previous week. The system did not indicate a duplicate treatment alert.
Insufficient information	130 (42.8%)	The report describes general information related to an error being identified or not reaching the patient (e.g., near miss) but does not include more specific information regarding the role of the person who caught the error.	Patient had duplicate orders of the sliding scale insulin at bedtime that had different algorithms. One prescription was ordered solely for bedtime, which was verified, and another order was placed for meals and bedtime, which was verified the next day. On two occasions, a nurse administered insulin from each order.

*Details of the PA-PSRS event narratives described in the Example column have been modified for readability and to preserve confidentiality.

Table 5. Frequency Counts, Percentages, Definitions, and Examples of Whether or Not the Patient Received a Duplicate Medication, N=304

Category	Frequency Count (%)	Definition	Example*
Yes	104 (34.2%)	The patient DID receive a duplicate dose of medication in the setting of a duplicate medication order error.	The patient was administered both tamsulosin and alfuzosin for five days. This is duplicate therapy. The patient is not supposed to be on both medications.
No	134 (44.1%)	In the setting of a duplicate medication order error, the patient DID NOT receive a duplicate dose of medication.	The patient was on Eliquis 5 mg PO BID and the provider ordered Lovenox 40 mg subq (subcutaneous) daily. The RPh noted the duplication and got the Lovenox discontinued. No doses reached the patient.
Insufficient information	66 (21.7%)	There is insufficient information in the report to determine whether or not the patient received a duplicate dose of medication as a result of a duplicate medication order error.	Duplicate orders for Levophed were noted.

*Details of the PA-PSRS event narratives described in the Example column have been modified for readability and to preserve confidentiality.

Discussion

Despite extensive research identifying the prevalence of duplicate medication order errors, factors contributing to these errors, and development of some solutions to address these errors, safety challenges remain. Over one-third of the duplicate medication order errors we analyzed resulted in a patient erroneously receiving a duplicate medication. Our focus on a detailed analysis of the specific types of duplicate medication order errors, contributing factors, and the context around these events provides important insights that can be used to address these errors.

Most of the duplicate medication order errors were of the type same order (43.1%). These types of errors in addition to same medication errors should be more easily identified by health IT systems that can crosscheck whether certain orders are, in fact, exact duplicates. The same therapeutic class error type may be more difficult to automatically prevent with health IT, given there are some differences in the two medication orders that need to be reconciled. However, a clinical team could evaluate instances, such as heparin and enoxaparin being ordered together (nearly the same medication and high-risk drugs), and decide if there should be a hard stop or other system design to prevent them from both being ordered as active medications.

Looking at the medication process tasks in which the duplicate medication order error was identified, based on the report text alone it is difficult to differentiate between pharmacy verification and medication reconciliation that may also be performed by a pharmacist but not explicitly stated in the report. From a staffing perspective, what is clear from the data is that pharmacists are central to the identification of duplicate medication order errors, with 36.5% of errors identified by a pharmacist. Nurses identified 19.1% of the duplicate medication order errors, often during the medication administration and monitoring tasks.

Although most reports did not have sufficient information to identify the factors contributing to the duplicate medication order error, the factors that were identified should be key areas of focus when developing strategies to address these errors. Health IT issues (20.7%), and specifically issues around alerting, were prominent. There were several reports that were associated with gaps in care coordination (14.5%), and from an information flow perspective, these errors may be due to interoperability issues that prevent health IT systems from communicating important information and enabling comparison of whether medications are duplicates. However, reports did not explicitly state interoperability as a reason, perhaps because reporters are not familiar with the interoperability issues related to their health IT systems. There were also several reports (17.1%) where an order for a prior dose or medication was not discontinued, which may have contributed to the duplicate medication order errors. Below, we describe systems-based approaches to addressing duplicate medication order errors that focus on health IT, people, and processes. Considering systems-based approaches is likely to be more effective and long-lasting than focusing solely on education and training.[19]

Strategies for Addressing Duplicate Medication Order Errors

Based on our analysis, as well as existing literature regarding how to address duplicate medication order errors, we recommend the following strategies:

- Health IT is likely playing a bigger role in duplicate medication order errors than is currently appreciated, given the known limitations of event reporting, the frequency with which reporters fail to identify health IT as a contributing factor to these errors, and the increasing body of literature identifying health IT as an issue.[20-22]
    - Facilities should study how health IT is contributing to or mitigating errors to gain a better understanding of these errors. We recommend facilities collect more detailed information on the health IT systems involved in duplicate medication order errors (e.g., CPOE; pharmacy health IT systems; nursing medication administration interfaces, including the electronic medication administration record and barcode medication administration devices; medication dispensing cabinets), interoperability between systems, and whether alerts are programmed into the health IT system and functioning as intended.
    - Facilities should review the frequency of duplicate medication error alerts and examine adherence to these alerts. When alerts are bypassed, facilities should analyze the context surrounding the alert to understand why it may have been bypassed and adjust the conditions triggering the alert accordingly. Many EHR vendors provide analysis tools to view alert adherence rates and these tools should be used regularly to monitor alerting.
    - Facilities should review usability aspects of duplicate medication order alerts. This should include reviewing whether the alert is occurring at the appropriate time in the clinicians' workflow and whether the alert is easily understandable by the audience the alert is intended for (e.g., physicians, nurses).
- Gaps in care coordination and communication issues that may be contributing to duplicate medication orders could be identified by conducting a Failure Modes and Effects Analysis (FMEA) to evaluate information flow during transitions in care.[23] Using an FMEA may allow facilities to pinpoint specific weaknesses and develop processes to address these weaknesses.
- Facilities should use existing tools to assess whether current CDS is in place that could prevent duplicate medication order errors. For example, the Leapfrog CDS tool has been shown to be effective at identifying where CDS can be improved.[24] In addition, facilities can develop their own test cases based on the common types of errors occurring at their facility.

The assessment tools should be used regularly since health IT systems are frequently updated with patches and new releases which can intentionally or unintentionally affect CDS functionality and may impact patient safety.

- Ensure a rigorous health IT governance process is in place to implement and maintain CDS rules that may prevent duplicate medication order errors. For example, there was a report that described an instance of a duplicate medication order error related to remdesivir because a CDS rule had not yet been implemented for this specific medication. Facilities should have a governance process that regularly reviews current CDS rules and considers new rules given evolving clinical practice.
- Some duplicate medication order errors are associated with the use of order sets. While there are several benefits to order sets, it is important to ensure the order sets are reviewed regularly and that CDS rules can effectively identify duplicate orders when order sets are being used.
- Process improvement efforts should include experts in medication safety, health IT, and human factors, as well as frontline healthcare team members. Making systems-based changes requires a diverse set of expertise.

Limitations

Our analysis was limited to the information provided in the patient safety event reports and we were not able to follow up with specific reporters or healthcare facilities for additional information about each described safety issue. Coding certain report information, such as medication process tasks and differentiating between pharmacy verification and medication reconciliation, can be challenging when limited information is presented. Additionally, this study analyzed patient safety event reports submitted to PA-PSRS and may not be fully representative of experiences outside of Pennsylvania. The search strategy we used to identify duplicate medication order error–related reports may not have identified all possible reports in the dataset. COVID-19 may have impacted the types of duplicate medication order errors reported and we were unable to identify whether patient safety reports were related to COVID-19.

Conclusion

Duplicate medication order errors continue to occur despite existing health IT interventions, with over one-third of analyzed reports resulting in a patient erroneously receiving a duplicate medication. Improvements can be made with a deeper understanding of the context surrounding these errors and contributing factors; however, healthcare facilities may need to collect additional information to gain these insights. Recommendations including in-depth analysis of health IT systems, use of FMEA, rigorous health IT governance, and review of CDS and order sets may help reduce duplicate medication errors.

Notes

This study was approved by the MedStar Health Research Institute institutional review board.

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