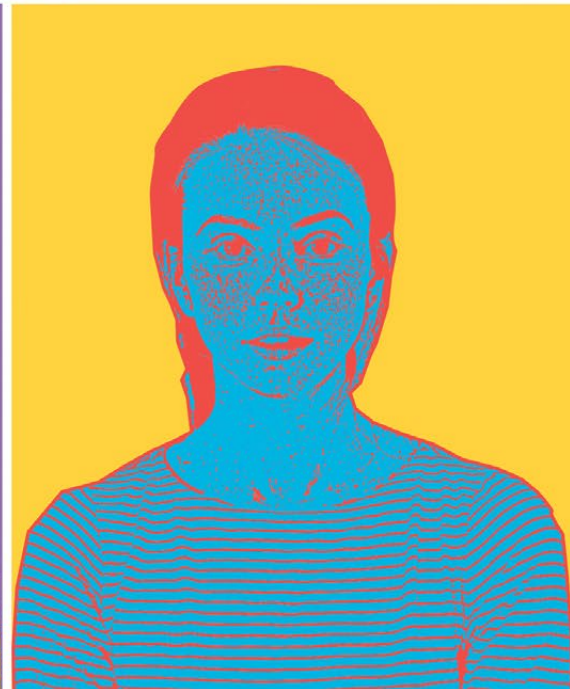
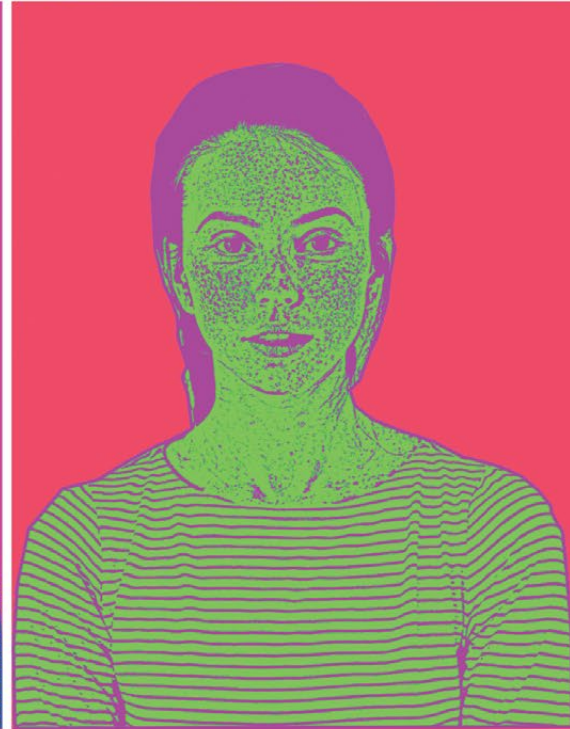






Health Information Technology– Related Wrong- Patient Errors:



Context is Critical

**Tracy C. Kim, BA^{♦♦}, Jessica L. Howe, MA[◇],
Ella S. Franklin, MSN[◇], Seth Krevat, MD[◇],
Rebecca Jones, MBA, RN[†], Katharine T. Adams, BA[◇],
Allan Fong, MS[◇], Jessica Oaks, MIT[†]
& Raj M. Ratwani, PhD^{◇†}**

DOI: 10.33940/data/2020.12.3

Submitted: August 5, 2020 / August 6, 2020



♦Corresponding author

◇MedStar Health National Center for Human Factors in Healthcare, Washington, DC

†Patient Safety Authority, Harrisburg, PA

*Georgetown University School of Medicine, Washington, DC

Disclosure: The authors declare that they have no relevant or material financial interests.

Health information technology (HIT) provides many benefits, but also facilitates certain types of errors, such as wrong-patient errors in which one patient is mistaken for another. These errors can have serious patient safety consequences and there has been significant effort to mitigate the risk of these errors through national patient safety goals, in-depth research, and the development of safety toolkits. Nonetheless, these errors persist. We analyzed 1,189 patient safety event reports using a safety science and resilience engineering approach, which focuses on identifying processes to discover errors before they reach the patient so these processes can be expanded. We analyzed the general care processes in which wrong-patient errors occurred, the clinical process step during which the error occurred and was discovered, and whether the error reached the patient. For those errors that reached the patient, we analyzed the impact on the patient, and for those that did not reach the patient, we analyzed how the error was caught. Our results demonstrate that errors occurred across multiple general care process areas, with 24.4% of wrong-patient error events reaching the patient. Analysis of clinical process steps indicated that most errors occurred during ordering/prescribing (n=498; 41.9%) and most errors were discovered during review of information (n=286; 24.1%). Patients were primarily impacted by inappropriate medication administration (n=110; 37.9%) and the wrong test or procedure being performed (n=65; 22.4%). When errors were caught before reaching the patient, this was primarily because of nurses, technicians, or other healthcare staff (n=303; 60.5%). The differences between the general care processes can inform wrong-patient error risk mitigation strategies. Based on these analyses and the broader literature, this study offers recommendations for addressing wrong-patient errors using safety science and resilience engineering, and it provides a unique lens for evaluating HIT wrong-patient errors.

Keywords: *wrong-patient, health information technology, patient safety*

Introduction

Electronic health records (EHRs) and other health information technology (HIT) provide numerous benefits, including better provider and patient accessibility to health information, and more efficient and effective care delivery.^{1,2} However, there are also unintended consequences of HIT use, including the technology facilitating certain types of errors.^{3,4} Wrong-patient errors, which occur when one patient is mistaken for another, is one type of HIT-facilitated error that includes situations like ordering a medication for the wrong patient, documenting in the wrong record, and uploading an X-ray to the wrong record. The occurrence of wrong-patient errors may not be immediately known, and these errors can lead to significant patient harm.

Recognizing the risks associated with wrong-patient errors, The Joint Commission's accreditation standards require the verification of patient identification before providing care, treatment, or services, and that two patient identifiers be used in the verification process.⁵ The Joint Commission's National Patient Safety Goals for hospitals and ambulatory care sites include patient identification. Further, there has been extensive research on HIT-facilitated wrong-patient errors that have provided insight for standards, safety goals, and the development of toolkits to mitigate the risk of these errors.⁶⁻¹¹ Despite these, HIT wrong-patient errors persist.^{10,12} For example, one recent study of physician interactions with computerized provider order entry (CPOE) found that 37.6% of the time, physicians did not verify patient identification information when placing orders in a simulated setting.¹⁰

Previous research, and resulting improvement efforts, are largely based on the analysis of instances where wrong-patient errors occurred and reached the patient, with a focus on the actions that

led to the error. While there are clear benefits to this approach, there are also benefits to analyzing instances where wrong-patient errors occurred and were discovered *before* they reached the patient to determine the specific people, processes, and/or technology that prevented the error from reaching the patient.

An analytic focus on instances where errors are caught before they reach the patient is based in two scientific areas. First, industrial safety science stresses that errors are going to occur in complex domains, like healthcare, and that while humans can be

HIT-facilitated errors include situations like ordering a medication for the wrong patient, documenting in the wrong record, and uploading an X-ray to the wrong record



a contributing factor to adverse safety events, they also play a crucial role as a “line of defense” against errors reaching patients.¹³ Humans can detect and correct errors that may stem from technology, organizational processes, or policies before patients are harmed. Second, resilience engineering is an approach that focuses on safety in complex domains, with a focus on how behaviors emerge and adapt. Humans are a critical part of the healthcare system and can rapidly adapt to perform their work and deliver care. When studying the behaviors that give rise to patient outcomes, it is important not only to focus on the behaviors that contribute to adverse outcomes, but also to focus on the behaviors that serve to prevent adverse outcomes.^{14,15} Safety science and resilience engineering provide a different lens on wrong-patient errors that could lead to additional recommendations for how to improve healthcare safety by expanding the application of processes discovered as working well.

In this paper, we first sought to better understand the pervasiveness of wrong-patient errors across care processes. We then focused on the context of wrong-patient errors, including identification of the people, specific processes, and/or technology that contributed to the errors that reached the patient, and how errors were discovered before they reached patients.

Previous Wrong-Patient Error Research and Proposed Solutions

Previous research has found that HIT-related wrong-patient errors often occurred during a patient’s clinical encounter, compared to before (e.g., registration, scheduling) or after (e.g., referrals, patient portals) the patient’s encounter. For example, a study of patient safety reports submitted by 181 healthcare organizations identified that 72.3% occurred during a clinical encounter, with several reports related to diagnostic procedures (e.g., laboratory tests, imaging; 36.5%) and treatment (e.g., medications, procedures; 22.1%). Most wrong-patient errors are considered near misses that do not reach the patient, and past research on HIT-related wrong-patient errors mostly has been focused on the ordering process and medication administration.^{6,16}

Wrong-Patient Errors During Ordering

Within the clinical encounter, wrong-patient errors during ordering of diagnostic images, labs, and medications have been a central focus of research efforts, given the prevalence of these errors. CPOE systems can facilitate wrong-patient errors due to poor usability, fragmented displays, and limited functionalities. For example, one study examining wrong-patient errors in radiology found that 50% of safety reports were related to order entry, and another study analyzing laboratory wrong-patient errors found that errors during order entry were the most frequent compared to other parts of the care process.^{16,17} Wrong-patient errors during medication ordering also have received considerable attention given the potential for significant patient harm if a patient receives the wrong medication or does not receive a medication that was intended for him/her.¹⁸

Several improvement efforts have focused on enhancing CPOE systems to reduce the occurrence of incorrect order entry. Numerous studies implemented a HIT verification alert pop-up requiring prescribers to confirm a patient’s identity prior to signing off on an order, which was found to reduce the number

One recent study of physician interactions with computerized provider order entry (CPOE) found that

37.6%

of the time, physicians did not verify patient identification information when placing orders in a simulated setting¹⁰

of wrong-patient errors.^{19–22} However, this intervention can also increase user frustration. Clinical decision support systems integrated within CPOE systems have also been tested, though not all studies resulted in a decrease in wrong-patient errors.^{23–25} Other improvement efforts have involved limiting the number of patient charts open concurrently in the EHR to reduce the likelihood of selecting the wrong patient’s record. While this solution showed early promise, recent studies have found that limiting the number of open charts made no significant difference in the number of wrong-patient orders.^{26–28}

Prior studies have also identified HIT enhancements to improve identification of wrong-patient errors in radiology. One study implemented radiopaque patient identification stickers as an additional check to ensure the patients’ conditions correlated with their imaging, and a second study involved capturing photographs of patients’ faces simultaneously with portable chest radiographs.^{29,30}

Wrong-Patient Errors During Medication Administration

Wrong-patient errors during medication administration have also been a prominent area of research given the frequency of errors and potential for significant patient harm. For example, one study reviewing safety reports from two hospitals found 10% of medication administration errors were related to wrong-patient errors.³¹ Similar to wrong-patient errors and CPOE systems, shortcomings in the design and implementation of barcode medication administration (BCMA) systems have been recognized as a challenge by some researchers.^{32,33} One study found 15 types of workarounds (steps performed out of sequence and unauthorized BCMA process steps) performed by nurses as a result of technology-related issues (e.g., connectivity, multiple scans needed to read barcode), all of which had wrong-patient errors listed as a possible negative outcome.³² Additionally, previous literature investigating BCMA’s role in reducing wrong-patient medication administration errors have been inconsistent in terms of significance of results.^{33,34}

Study Focus

With the extensive research on HIT-related wrong-patient errors and recognition that these errors persist, we analyzed patient safety event (PSE) reports with a focus on the contextual details of each report. We analyzed the general care process and clinical process step during which HIT wrong-patient errors occurred and were discovered, whether the error reached the patient, and the impact on the patient or how the error was caught. Importantly, we compared the clinical process steps involved for errors that reached the patient and those that were caught before reaching the patient. This approach affords the opportunity to identify the people, processes, or technology that may effectively enable the identification of wrong-patient errors before reaching the patient. With this knowledge, those specific processes can be shared and may serve to inform performance optimization within healthcare facilities.

Methods

Data Source and Selection

Data were comprised of all safety reports submitted to the Pennsylvania Patient Safety Reporting System (PA-PSRS)* between January 1 and December 31, 2019, which comprised 293,400 reports from 595 facilities. To identify possible HIT- and wrong-patient-related reports, we used a three-pronged retrieval process that included reports in which the:

- Reporter assigned a subevent type category of “wrong patient” or similar subevent type (e.g., “wrong patient requested,” or “wrong patient transfused” in the Transfusion event type category), or
- Reporter categorized the issue as HIT-related and the description contained a keyword (e.g., “wrong-person”) indicating it may be wrong-patient-related, or
- Report was identified as HIT-related from a machine learning algorithm, which was previously developed to identify HIT-related reports based on the free-text description in patient safety event reports, and contained a keyword indicating it may be wrong-patient-related.³⁵

This search returned 3,114 reports, which were manually reviewed to determine if they were HIT-related; 1,433 reports met this criterion. After reviewing the 1,433 reports to determine if they were wrong-patient-related, 244 were excluded. In total, 1,189 reports were verified to be both HIT- and wrong-patient-related, and thus were included in the descriptive and qualitative analyses. The data selection process is outlined in **Figure 1**.

Analysis Methods

A descriptive analysis of the 1,189 HIT wrong-patient reports included harm score and facility type as reported by healthcare facilities to

PA-PSRS. Harm scores were categorized as an unsafe condition, an event with no harm, or an event with harm.

For the qualitative analysis, a grounded theory approach was used.³⁶ The free-text narratives of each report served as the foundation for coding. The codebook, including definitions and examples, is described in **Tables 1** and **2**. Two human factors experts manually coded all reports for general care process, clinical process step during which HIT wrong-patient errors occurred and were discovered, and if the HIT wrong-patient error reached the patient. First, each report was categorized into one of six general care processes in which the error primarily occurred (i.e., administrative, general, laboratory, medication, procedure, radiology). The reports were then categorized by the clinical process step during which the wrong-patient error occurred and the step during which the error was discovered. Each report was also coded for whether the error reached the patient, the error did not reach the patient, or there was insufficient information to make the determination. Reports were coded as reaching the patient if the error resulted in the patient’s care being altered in any way, such as a delay in care or the wrong procedure being performed, or a patient receiving the wrong information, such as test results or discharge instructions, as a result of a HIT wrong-patient error. For those errors that reached the patient, the immediate impact on the patient was categorized into one of five categories, shown in **Table 2**. For those errors that did not reach the patient, the person or technology (i.e., HIT system) that caught the error was categorized into one of five categories, shown in **Table 2**.

Fifteen percent of the reports were dually coded. Inter-rater reliability was calculated using Cohen’s kappa (.9 for general care process, .8 for clinical process step, and .8 for reached patient).

Results

From the 293,400 reports submitted in calendar year 2019, 3,114 (1.1%) were initially identified as potentially HIT wrong-patient errors and 1,189 (0.4%) were confirmed through expert review. We first present the descriptive analysis with harm score and facility type followed by the qualitative analysis of general care process, clinical process step during which HIT wrong-patient errors occurred and were discovered, and whether the error reached the patient, with descriptions of the impact on the patient or how the error was caught.

Descriptive Analyses

Harm Score. Of the 1,189 PSE reports analyzed, nearly all reports were either unsafe conditions or events with no harm (n=1,188; 99.9%). There was 1 event with harm (0.1%).

Facility Type. Of the 1,189 PSE reports analyzed, the majority were from hospitals (n=1,186; 99.7%), with 3 reports from ambulatory surgical facilities (0.3%).

*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). All reports submitted through PA-PSRS are confidential and no information about individual facilities or providers is made public.

Figure 1. HIT Wrong-Patient Data Selection Process from PA-PSRS (Calendar Year 2019)



Qualitative Analyses

We report the general care process involved, the clinical process steps during which the HIT wrong-patient error occurred and was discovered, and whether errors reached the patient. Following these analyses, we focus on the four general care processes in which errors were most frequently involved to determine the most common clinical process steps during which the error occurred and how they were discovered.

General Care Process. The prominent general care processes in which HIT wrong-patient errors occurred were radiology (n=295; 24.8%), medication, (n=283; 23.8%), laboratory (n=241; 20.3%), and procedures (n=224; 18.8%), followed by administrative (n=95; 8.0%) and general (n=51; 4.3%).

Clinical Process Steps During Which HIT Wrong-Patient Errors Occurred and Were Discovered. Analyzing where the errors occurred, most were during prescribing/ordering (n=498; 41.9%), followed by registration (n=110; 9.3%), and before or during imaging (n=96; 8.1%).

Analyzing where the errors were discovered, approximately one-quarter of errors were discovered when reviewing information (n=286; 24.1%) followed by review of results (n=119; 10.0%). For nearly half of the reports, there was insufficient information to identify where the error was discovered (n=524; 44.1%). All frequency counts and percentages for clinical process steps during which errors occurred and where the errors were discovered are displayed in **Table 1**.

Table 1: Frequency Counts, Percentages, Definitions, and Examples of Categories for General Care Process and Clinical Process Step

	Frequency Count (%)	Definition	Example
General Care Process, N=1,189			
Administrative	95 (8.0%)	Reports related to registration, scheduling, admission, consent processing, billing, referrals, consults, scanning, faxing, and uploading documents.	The wrong patient's document was scanned into a patient's electronic chart.
General	51 (4.3%)	Reports that contain general language of HIT wrong-patient errors and do not identify whether an error was related to administrative, laboratory, medication, procedure, radiology, or other care processes.	A nurse documented a patient's weight in the incorrect electronic chart.
Laboratory	241 (20.3%)	Reports related to the ordering, labelling, collection, processing, and/or documentation of results of a clinical specimen or other laboratory procedures. Includes reports related to a specimen or blood test that does not specify whether it is a point of care test.	A nurse drew labs on a patient that were ordered for another patient.
Medication	283 (23.8%)	Reports related to the ordering and labeling, and/or the prescribing, retrieval, administration and documentation of a medication. Includes reports related to the electronic medication administration record (eMAR) and the selection of medications or wrong patients in an automated dispensing system.	A medication was ordered for a different patient than the one for whom it was intended.
Procedure	224 (18.8%)	Reports related to the ordering, processing, interruption, and/or documentation of results for procedures. Includes reports related to preop procedures, surgery, dialysis, point of care tests (e.g., iSTAT, urine dip), biopsies, transfusions, telemetry strips, and EKG/ECG.	The point-of-care urine analyzer was run under the wrong patient identification number.
Radiology	295 (24.8%)	Reports related to the ordering, processing, interpretation, and/or documentation of results for imaging. Includes reports related to CT scans, ultrasounds, and MRIs.	A patient's ultrasound was performed under the incorrect patient name.

Table 1 (continued): Frequency Counts, Percentages, Definitions, and Examples of Categories for General Care Process and Clinical Process Step

	Error Occurred	Error Discovered	Definition	Example
Clinical Process Step, N=1,189				
Before or during imaging	96 (8.1%)	91 (7.7%)	Report states HIT wrong-patient error occurred or was discovered before or during imaging. Includes errors related to patient verification and scanning or entering wrong patient information into a HIT system before a medical imaging procedure, as well as those identified immediately after obtaining an image but before it was sent or uploaded for interpretation.	Outpatient MRI done on correct patient but under incorrect name on scanner.
Before or during labs	37 (3.1%)	15 (1.3%)	Report states HIT wrong-patient error occurred or was discovered before or during laboratory specimen analysis. Includes errors related to the collection of specimens, patient verification and scanning, or entering wrong patient information into a HIT system before analyzing specimen, as well as those identified immediately after analyzing specimen but prior to inputting results into a HIT system.	The operator entered the incorrect patient identifier into the analyzer.
Before or during medication administration	24 (2.0%)	40 (3.4%)	Report states HIT wrong-patient error occurred or was discovered before or during medication administration. Includes errors related to patient verification, scanning patient barcodes or medications when an automated dispensing system was not mentioned, and opening up the wrong patient chart during administration.	Patient was started on respiratory treatment that was ordered for a different patient.
Before or during procedure	83 (7.0%)	19 (1.6%)	Report states HIT wrong-patient error occurred or was discovered before or during a procedure. Includes errors related to patient verification and scanning patient barcodes or entering patient identifiers into test equipment.	The incorrect patient identification number was entered into the point-of-care testing machine and utilized to perform and result the patient test.
Dispensing medication	35 (2.9%)	1 (0.1%)	Report states HIT wrong-patient error occurred or was discovered during the process of a clinician dispensing medication from a HIT system (e.g., automatic dispensing system).	Medication found to have been pulled from Pyxis on wrong patient but administered to correct patient.
Documentation	94 (7.9%)	25 (2.1%)	Report states HIT wrong-patient error occurred or was discovered during clinician or staff documentation within a HIT system. Includes errors related to dictating, charting on the wrong-patient, and e-messages containing wrong-patient information or being sent for the wrong-patient.	Charted under the wrong patient in the electronic health record.
Inputting results	74 (6.2%)	2 (0.2%)	Report states HIT wrong-patient error occurred or was discovered related to incorrectly inputting results into a HIT system for a wrong-patient. Includes errors related to inputting lab or imaging results into a patient's records with no explicit mention of whether the error was related to entering wrong-patient information before or during a procedure, lab or imaging.	Wrong patient results were entered into another patient's chart.
Labeling	21 (1.8%)	2 (0.2%)	Report states HIT wrong-patient error occurred or was discovered during the labeling process and that resulted from mislabeled documents, specimen, equipment or printed images. Excludes reports describing errors related to staff generating, handwriting, or retrieving labels to perform a test when "mislabeled" or "labeled" are not included in the narrative.	Specimen was mislabeled and now the results are in the incorrect patient chart.
Other	10 (0.8%)	NA	Report states HIT wrong-patient error that occurred outside of the clinical process codes or as a result of a HIT system error (not user-error). Includes errors related to discharge.	Technician reported that there had been a system issue and the wrong patient images were in the wrong chart.

	Error Occurred	Error Discovered	Definition	Example
Clinical Process Step, N=1,189				
Patient engagement	NA	32 (2.7%)	Report states HIT wrong-patient error that was discovered by a patient at any point of care. Includes errors discovered prior to a patient's arrival to a facility, during admission or an appointment, and after leaving a medical facility that were discovered in-person, from a follow-up call or from a patient portal.	Error found upon discharge when patient verified information.
Prescribing/ ordering	498 (41.9%)	19 (1.6%)	Report states HIT wrong-patient error that occurred or was discovered during the ordering or prescription of medications, images, referrals, or other care procedures. Includes errors related to consult or physician requests, discharge, and orders for a wrong patient scanned into a HIT system.	Lab orders ordered under wrong patient.
Registration	110 (9.3%)	9 (0.8%)	Report states HIT wrong-patient error occurred or was discovered during the process of patient registration or admission.	Patient was admitted under an incorrect medical record number (MRN) belonging to a different patient.
Review of results	1 (0.1%)	119 (10.0%)	Report states HIT wrong-patient error occurred or was discovered from a clinician reviewing test results in a HIT system.	Patient given 400 mg levetiracetam seven hours earlier than planned because EEG thought to show 15-second seizure. EEG was actually of a different patient.
Reviewing information	2 (0.2%)	286 (24.1%)	Report states HIT wrong-patient error occurred or was discovered when reviewing information related to patient care from a HIT system. Includes clinicians (e.g., pharmacy) reviewing orders and calling for verification.	Nurse opened incorrect patient chart and read order for oral contrast.
Scanning documents	66 (5.6%)	3 (0.3%)	Report states HIT wrong-patient error occurred or was discovered during the process of scanning care-related documents into a HIT system. Excludes orders scanned into a HIT system.	Auditing charts and found another patient's paperwork scanned into wrong record.
Scheduling	20 (1.7%)	2 (0.2%)	Report states HIT wrong-patient error occurred or was discovered during the process of scheduling a patient appointment, outpatient exam, or any other care process.	This patient was scheduled for an abdominal ultrasound but it was the wrong patient.
Insufficient information	18 (1.5%)	524 (44.1%)	Report does not explicitly state how or at what point of care the HIT wrong-patient error occurred or was discovered.	The wrong patient information was found on patient's chart.

Analysis of Whether the Report Reached Patient. Distinct from the severity level entered by the reporter, as part of our analysis, we identified whether the error described by the reporter reached the patient. Of the 1,189 errors, 290 (24.4%) reached the patient, 501 (42.1%) did not reach the patient, and for 398 reports (33.5%) there was insufficient information to determine if the error reached the patient.

Of the 290 errors that reached the patient, over one-third of reports resulted in inaccurate medication administration (n=110; 37.9%); followed by wrong test or procedure performed (n=65; 22.4%); and retest, redraw, or reimage due to results going to the wrong patient (n=56; 19.3%), shown in **Table 2**.

Of the 501 HIT wrong-patient errors that did not reach the patient, errors were frequently caught by a nurse, technician, or other healthcare staff (n=303; 60.5%). There was insufficient information in 161 (32.1%) HIT wrong-patient reports that did not reach the patient to determine how the error was caught. Very few errors were reported as being caught by a physician or advanced practice provider (n=16; 3.2%); HIT system (n=12; 2.4%); or patient, caregiver, or family member (n=9; 1.8%). All frequency counts and percentages for categories related to impact on the patient and how the errors were caught are displayed in **Table 2**, and frequency counts and percentages of whether a HIT wrong-patient error reached the patient, by the clinical process step during which it occurred and was discovered, are shown in **Table 3**.

Focused Analysis on Prominent General Care Processes. Reports categorized as radiology, medication, laboratory, or procedures, which were the general care processes with the highest frequency of reports, were further analyzed to identify the clinical process steps that were associated with errors that reached the patient and did not reach the patient. When comparing the clinical process steps, we focused on the highest frequency categories, excluding the category of insufficient information, since this category does not provide information on an identifiable clinical process step.

Radiology-Specific Reports. Of the 295 radiology related reports, 71 (24.1%) reached the patient, 159 (53.9%) did not reach the patient, and for the remaining 65 reports (22.0%) there was insufficient information to determine whether the error reached the patient.

Of the 71 radiology-related errors that reached the patient, the most frequent identifiable clinical process steps during which errors *occurred* included prescribing/ordering (n=36; 50.7%), and before or during imaging (n=22; 31.1%). The most frequent identifiable clinical process steps during which errors were *discovered* included before or during imaging (n=17; 23.9%) and review of results (n=12; 16.9%).

Of the 159 radiology-related errors that did not reach the patient, the most frequent identifiable clinical process steps during which errors *occurred* included prescribing/ordering (n=94; 59.1%) and before or during imaging (n=48; 30.2%), similar to errors that reached the patient. The most frequent identifiable clinical process steps during which errors were *discovered* included before or during imaging (n=69; 43.4%) and, different from errors that reached the patient, reviewing information (n=27; 17.0%). Additional details regarding errors involving radiology clinical process steps are in **Table 4**.

Medication-Specific Reports. Of the 283 medication related reports, 113 (39.9%) reached the patient, 134 (47.3%) did not reach the patient, and for the remaining 36 reports (12.7%) there was insufficient information to determine whether the error reached the patient.

Of the 113 medication-related errors that reached the patient, the most frequent identifiable clinical process steps during which errors *occurred* included prescribing/ordering (n=66; 58.4%) and before or during medication administration (n=21; 18.6%). The most frequent identifiable clinical process steps during which errors were *discovered* included before or during medication administration (n=28; 24.8%) and reviewing information (n=17; 15.0%).

Of the 134 medication-related errors that did not reach the patient, the most frequent identifiable clinical process steps during which errors *occurred* included prescribing/ordering (n=114; 85.1%) and, different from errors that reached the patient, dispensing medication (n=9; 6.7%). The most frequent identifiable clinical process steps during which errors were *discovered* included reviewing information (n=98; 73.0%) and before or during medication administration (n=7; 5.2%), similar to when the error reached the patient. Additional details regarding errors involving medication clinical process steps are in **Table 5**.

Laboratory-Specific Reports. Of the 241 laboratory-related reports, 61 (25.3%) reached the patient, 66 (27.4%) reports did not reach the patient, and for the remaining 114 reports (47.3%) there was insufficient information to determine whether the error reached the patient.

Of the 61 laboratory-related errors that reached the patient, the most frequent identifiable clinical process steps during which errors *occurred* included prescribing/ordering (n=31; 50.8%) and before or during labs (n=11; 18.0%). The most frequent identifiable clinical process steps during which errors were *discovered* included review of results (n=20; 32.8%) and reviewing information (n=8; 13.1%).

Of the 66 laboratory-related errors that did not reach the patient, the most frequent identifiable clinical process steps during which errors *occurred* included prescribing/ordering (n=29; 43.9%) and before or during labs (n=11; 16.7%), similar to errors that reached the patient. The most frequent identifiable clinical process steps during which the error was *discovered* included review of results (n=18; 27.3%) and reviewing information (n=14; 21.2%), also similar to errors that reached the patient. Additional details regarding errors involving laboratory clinical process steps are in **Table 6**.

Procedure-Specific Reports. Of the 224 procedure-related reports, 23 (10.3%) reached the patient, 76 reports (33.9%) did not reach the patient, and for the remaining 125 reports (55.8%) there was insufficient information to determine whether the error reached the patient.

Of the 23 procedure-related errors that reached the patient, the most frequent identifiable clinical process steps during which errors *occurred* included before or during procedure (n=9; 39.1%), prescribing/ordering (n=3; 13.0%), and registration (n=3; 13.0%). The most frequent identifiable clinical process steps during which errors were *discovered* included patient engagement (n=4; 17.4%) and reviewing information (n=3; 13.0%).

Of the 76 procedure-related errors that did not reach the patient, the most frequent identifiable clinical process steps during which errors *occurred* included prescribing/ordering (n=25; 32.9%) and before or during procedure (n=21; 27.6%), similar to errors that reached the patient. The most frequent identifiable clinical process steps during which errors were *discovered* included reviewing information (n=34; 44.7%) and, different from errors that reached the patient, before or during a procedure (n=14; 18.4%). Additional details regarding errors involving procedure clinical process steps are in **Table 7**.

Discussion

While there are national patient safety goals, extensive research, and specific safety improvement tools focused on reducing HIT-related wrong-patient errors, our descriptive and qualitative analyses of thousands of reports from over 500 healthcare facilities show that HIT-related wrong-patient errors persist. Of the 293,400 reports submitted to PA-PSRS in calendar year 2019, 3,114 (1.1%) were initially identified as potential HIT wrong-patient

Table 2: Frequency Counts, Percentages, Definitions, and Examples of Categories for Impact on the Patient and How the Error was Caught

Impact on the Patient (coded when the error reached the patient), N=290			
Delay in care	26 (9.0%)	A patient's care is delayed due to: • Results going to the wrong patient but can be transferred back to the correct patient (retest, redraw, reimage not needed) • The wrong patient's results are in the record • A registration error • An order, consult, or appointment on the wrong patient	A patient's X-ray was uploaded to a different patient's record. The X-ray was moved back to the right patient with technical support that took time and resulted in a delay in care.
Inaccurate medication administration	110 (37.9%)	A patient received a medication intended for another patient, or received the correct medication administered at a time, dose, or route that was intended for another patient.	Heparin was ordered and given to the wrong patient.
Other	33 (11.4%)	A wrong-patient error results in the patient receiving information that was not intended for them, including: • Prescriptions • Patient portal messages/results • Lab orders • Appointments	Patient received patient portal message of dietary recommendations and medication information from physician intended for another patient.
Retest, redraw, or reimage due to results going to the wrong patient	56 (19.3%)	A patient had the correct test, sample, or image collected, but results were entered on the wrong patient and required a retest, redraw, or reimage.	The tech performed an EKG and uploaded the results to the wrong patient record requiring the need to retest.
Wrong test or procedure performed	65 (22.4%)	A patient had a lab, imaging, or other procedure or test performed that was intended for another patient, including specimen collection.	The CT scan was performed on the wrong patient.
How the Error was Caught (coded when the error did not reach the patient), N=501			
HIT system	12 (2.4%)	Reports related to an error being identified by a HIT system (e.g., alert) prior to reaching a patient.	Upon entering a patient's weight in the wrong patient's chart, the weight alert fired.
Nurse, technician, or healthcare staff	303 (60.5%)	Reports related to an error being identified by a nurse, technician, or healthcare staff person prior to reaching the patient.	The technician questioned the physician about the order for the patient and it was discovered it was placed on the wrong patient.
Patient, caregiver, or family member	9 (1.8%)	Reports related to an error being identified by a patient, caregiver, or family member prior to reaching the patient.	When nurse described the need to be transported for an X-ray, the patient questioned the need for an X-ray and it was discovered this was for a different patient.
Physician or advanced practice provider	16 (3.2%)	Reports related to an error being identified by a provider (including attending, fellow, and resident physicians; physician assistants; and nurse practitioners).	Medication ordered for the wrong patient and identified immediately by the physician.
Insufficient information	161 (32.1%)	Reports that contain general information related to an error being identified or not reaching a patient (e.g., near miss) but do not include more specification regarding how it was identified.	Near miss, did not reach the patient.

errors using a three-pronged retrieval process and 1,189 (0.4%) were confirmed through expert review. Findings from the qualitative analysis revealed that nearly 90% of the wrong-patient errors were associated with radiology (24.8%), medication (23.8%),

laboratory (20.3%), or procedure (18.8%) general care processes, shown in **Table 1**. While most of the HIT wrong-patient related error reports reviewed described errors that did not reach the patient, 24.4% of the reports described errors that did. When the

errors reached the patient, our analyses show that the impact on the patient was frequently inaccurate medication administration (37.9% of errors reaching the patient) or the wrong test or procedure performed on the patient (22.4% of errors reaching the patient), both of which are issues that have the potential for significant patient harm. (See **Table 2.**)

Healthcare worker (e.g., nurse, technician, or other healthcare staff) workflow processes and verbal communication practices with patients, family members, and other staff often caught errors before they reached and potentially harmed the patient. These findings underscore the role of humans as a safety “line of defense” in complex healthcare environments. Within the reports, there were few instances of physicians and advanced practice providers; HIT systems, such as alerts; or patient, caregiver, or family members catching errors, which may be due to the underreporting of those details or events.³⁷

Focusing on Processes Associated With Catching Errors

Unique to our HIT wrong-patient error analysis is the focus on where the error occurred and where it was discovered. Across all 1,189 general care processes, most errors occurred during prescribing/ordering (n=498; 41.9%) replicating previous research.^{6,8,11} When it could be determined how errors were discovered, it was primarily through reviewing information (n=286; 24.1%).

Looking at the prominent general care processes individually and analyzing where the error occurred and where it was discovered for reports that reached the patient and those that did not, reveals important differences that are not appreciated when findings are collapsed across general care processes. Where there are patterns of clinical process steps that are serving to discover errors before reaching the patient, a safety science and resilience engineering approach of learning from these instances and expanding these practices can be used. Our analyses identified several interesting patterns.

- For radiology-related wrong-patient errors, nearly 50% of errors occurred during the ordering process, and when these errors were caught before reaching the patient, it was just before or during imaging as well as when reviewing information. These clinical process steps served to catch over 60% of the errors that did not reach the patient.
- For medication-related wrong-patient errors, over 70% of errors occurred during prescribing or ordering, and when these errors were discovered, before reaching the patient, over 70% of the time it was when reviewing information.
- For laboratory-related wrong-patient errors, nearly 40% of the errors occurred during the ordering process, and when these errors were discovered, before reaching the patient, it was during the review of results, review of information, and before or during labs.
- For procedure-related wrong-patient errors, over a third of the errors occurred before or during the procedure, and when these errors were caught, before reaching the patient, over 70% of the time it was when reviewing information or just before or during the procedure.

Reviewing information was a critical process step for catching errors before they reached the patient in all four general care pro-

cesses, confirming the importance of taking time to deliberately review patient identifiers. For three of the four general care processes, the time just before or during the clinical activity was also important for catching errors before they reached the patient, suggesting that time-outs and other deliberate actions to pause activity may be important for catching errors.

Recommendations for Reducing Wrong-Patient Errors

Based on our analyses, previous literature, and recommendations from other organizations, we highlight the following:

- As this study and previous studies have found, wrong-patient errors often occur during the ordering process. We recommend reviewing provider workflow processes to ensure it includes checking at least two patient identifiers.^{6,7} Additionally, EHR ordering screens may be cluttered, making it difficult to find patient identifiers, and these identifiers may not always be consistently displayed across different screens.¹⁰ Therefore, using existing toolkits to optimize HIT and workflow processes may be beneficial.⁸
- Task interruptions have been identified as a potential cause of wrong-patient errors during the ordering process.^{19,20,26} As a result, we recommend ordering providers develop strategies to manage interruptions, including:³⁸
- Placing orders in an environment that is not prone to interruptions.
- When interrupted, attempt to complete the task or place a reminder for where to resume work, such as a Post-it note or the mouse cursor. This will support accurate resumption of the interrupted task since you can look back at this reminder.
- When interrupted, ask the person interrupting you to wait for a few minutes while you complete the task of placing the order.
- We recommend that healthcare facilities review their safety reports related to wrong-patient errors to determine where existing issues reside. Interview providers and other staff to determine where they believe hazards are. Ask providers and staff about clinical process steps that they believe serve to discover errors before they reach patients, as well as where gaps exist. Once successful processes are identified, the application of these processes should be expanded.
- Across the four prominent general processes of radiology, medication, laboratory, and procedure, reviewing information was important for catching errors before they reached patients. Reiterating this importance of reviewing information and rewarding staff when these behaviors are observed will serve to reinforce this practice.
- Reviewing of information just before or during the clinical activity was also important for discovering errors before reaching the patient. Healthcare facilities should reinforce the importance of identity verification before and during clinical activities and determine whether specific time-outs or other deliberate pauses would be beneficial.

Table 3: Total Frequency Counts and Percentages for Whether a HIT Wrong-Patient Error Did or Did Not Reach the Patient by the Clinical Process Step in Which It Occurred and Was Discovered

	Total			
	All	Reached Patient	Did Not Reach Patient	Insufficient Information
Error Occurred				
Before or during imaging	96 (8.1%)	22 (7.7%)	48 (9.5%)	26 (6.5%)
Before or during labs	37 (3.1%)	11 (3.8%)	11 (2.2%)	15 (3.8%)
Before or during medication administration	24 (2.0%)	21 (7.2%)	2 (0.4%)	1 (0.3%)
Before or during procedure	83 (7.0%)	9 (3.1%)	21 (4.2%)	53 (13.3%)
Dispensing medication	35 (2.9%)	20 (6.9%)	9 (1.8%)	6 (1.5%)
Documentation	94 (7.9%)	8 (2.8%)	50 (10.0%)	36 (9.0%)
Inputting results	74 (6.2%)	13 (4.5%)	17 (3.4%)	44 (11.1%)
Labeling	21 (1.8%)	7 (2.4%)	10 (2.0%)	4 (1.0%)
Other	10 (0.8%)	1 (0.3%)	5 (1.0%)	4 (1.0%)
Patient engagement	--	--	--	--
Prescribing/ordering	498 (41.9%)	141 (48.6%)	267 (53.3%)	90 (22.6%)
Registration	110 (9.3%)	22 (7.7%)	21 (4.2%)	67 (16.8%)
Review of results	1 (0.1%)	1 (0.3%)	--	--
Reviewing information	2 (0.2%)	1 (0.3%)	1 (0.2%)	--
Scanning documents	66 (5.6%)	5 (1.7%)	22 (4.4%)	39 (9.8%)
Scheduling	20 (1.7%)	3 (1.0%)	10 (2.0%)	7 (1.8%)
Insufficient information	18 (1.5%)	5 (1.7%)	7 (1.4%)	6 (1.5%)
Total	1,189 (100%)	290 (100%)	501 (100%)	398 (100%)
Error Discovered				
Before or during imaging	91 (7.7%)	17 (5.9%)	69 (13.8%)	5 (1.2%)
Before or during labs	15 (1.3%)	3 (1.0%)	9 (1.8%)	3 (0.8%)
Before or during medication administration	40 (3.4%)	28 (9.8%)	7 (1.4%)	5 (1.2%)
Before or during procedure	19 (1.6%)	2 (0.7%)	14 (2.8%)	3 (0.8%)
Dispensing medication	1 (0.1%)	--	1 (0.2%)	--
Documentation	25 (2.1%)	1 (0.3%)	21 (4.2%)	3 (0.8%)
Inputting results	2 (0.2%)	--	2 (0.4%)	--
Labeling	2 (0.2%)	--	2 (0.4%)	--
Other	--	--	--	--
Patient engagement	32 (2.7%)	23 (7.9%)	6 (1.2%)	3 (0.8%)
Prescribing/ordering	19 (1.6%)	5 (1.7%)	12 (2.4%)	2 (0.5%)
Registration	9 (0.8%)	2 (0.7%)	5 (1.0%)	2 (0.5%)
Review of results	119 (10.0%)	34 (11.7%)	36 (7.2%)	49 (12.3%)
Reviewing information	286 (24.1%)	38 (13.1%)	199 (39.7%)	49 (12.3%)
Scanning documents	3 (0.3%)	--	2 (0.4%)	1 (0.3%)
Scheduling	2 (0.2%)	--	2 (0.4%)	--
Insufficient information	524 (44.1%)	137 (47.2%)	114 (22.7%)	273 (68.5%)
Total	1,189 (100%)	290 (100%)	501 (100%)	398 (100%)

Table 4: Radiology Frequency Counts and Percentages for Whether a HIT Wrong-Patient Error Did or Did not Reach the Patient by the Clinical Process Step in Which It Occurred and Was Discovered

	Radiology			
	All	Reached Patient	Did Not Reach Patient	Insufficient Information
Error Occurred				
Before or during imaging	96 (32.5%)	22 (31.1%)	48 (30.2%)	26 (40.0%)
Before or during labs	--	--	--	--
Before or during medication administration	--	--	--	--
Before or during procedure	--	--	--	--
Dispensing medication	--	--	--	--
Documentation	1 (0.3%)	--	--	1 (1.5%)
Inputting results	17 (5.8%)	5 (7.0%)	6 (3.8%)	6 (9.3%)
Labeling	1 (0.3%)	--	--	1 (1.5%)
Other	2 (0.7%)	--	1 (0.6%)	1 (1.5%)
Patient engagement	--	--	--	--
Prescribing/ordering	147 (49.8%)	36 (50.7%)	94 (59.1%)	17 (26.2%)
Registration	20 (6.8%)	5 (7.0%)	6 (3.8%)	9 (13.9%)
Review of results	--	--	--	--
Reviewing information	--	--	--	--
Scanning documents	2 (0.7%)	--	2 (1.3%)	--
Scheduling	4 (1.4%)	--	1 (0.6%)	3 (4.6%)
Insufficient information	5 (1.7%)	3 (4.2%)	1 (0.6%)	1 (1.5%)
Total	295 (100%)	71 (100%)	159 (100%)	65 (100%)
Error Discovered				
Before or during imaging	91 (30.8%)	17 (23.9%)	69 (43.4%)	5 (7.7%)
Before or during labs	--	--	--	--
Before or during medication administration	--	--	--	--
Before or during procedure	--	--	--	--
Dispensing medication	--	--	--	--
Documentation	--	--	--	--
Inputting results	1 (0.3%)	--	1 (0.6%)	--
Labeling	--	--	--	--
Other	--	--	--	--
Patient engagement	4 (1.4%)	2 (2.8%)	1 (0.6%)	1 (1.5%)
Prescribing/ordering	1 (0.3%)	--	1 (0.6%)	--
Registration	1 (0.3%)	--	1 (0.6%)	--
Review of results	35 (11.9%)	12 (16.9%)	13 (8.2%)	10 (15.4%)
Reviewing information	38 (12.9%)	6 (8.5%)	27 (17.0%)	5 (7.7%)
Scanning documents	--	--	--	--
Scheduling	--	--	--	--
Insufficient information	124 (42.2%)	34 (47.9%)	46 (29.0%)	44 (67.7%)
Total	295 (100%)	71 (100%)	159 (100%)	65 (100%)

Table 5: Medication Frequency Counts and Percentages for Whether a HIT Wrong-Patient Error Did or Did not Reach the Patient by the Clinical Process Step in Which It Occurred and Was Discovered

	Medication			
	All	Reached Patient	Did Not Reach Patient	Insufficient Information
Error Occurred				
Before or during imaging	--	--	--	--
Before or during labs	--	--	--	--
Before or during medication administration	24 (8.5%)	21 (18.6%)	2 (1.5%)	1 (2.8%)
Before or during procedure	--	--	--	--
Dispensing medication	35 (12.4%)	20 (17.7%)	9 (6.7%)	6 (16.7%)
Documentation	12 (4.2%)	3 (2.6%)	6 (4.4%)	3 (8.3%)
Inputting results	--	--	--	--
Labeling	4 (1.4%)	2 (1.8%)	2 (1.5%)	--
Other	--	--	--	--
Patient engagement	--	--	--	--
Prescribing/ordering	206 (72.8%)	66 (58.4%)	114 (85.1%)	26 (72.2%)
Registration	--	--	--	--
Review of results	--	--	--	--
Reviewing information	1 (0.4%)	1 (0.9%)	--	--
Scanning documents	--	--	--	--
Scheduling	--	--	--	--
Insufficient information	1 (0.4%)	--	1 (0.8%)	--
Total	283 (100%)	113 (100%)	134 (100%)	36 (100%)
Error Discovered				
Before or during imaging	--	--	--	--
Before or during labs	--	--	--	--
Before or during medication administration	40 (14.1%)	28 (24.8%)	7 (5.2%)	5 (13.9%)
Before or during procedure	--	--	--	--
Dispensing medication	1 (0.4%)	--	1 (0.8%)	--
Documentation	1 (0.4%)	1 (0.9%)	--	--
Inputting results	--	--	--	--
Labeling	--	--	--	--
Other	--	--	--	--
Patient engagement	4 (1.4%)	2 (1.8%)	2 (1.5%)	--
Prescribing/ordering	10 (3.5%)	4 (3.5%)	5 (3.7%)	1 (2.8%)
Registration	--	--	--	--
Review of results	--	--	--	--
Reviewing information	121 (42.8%)	17 (15.0%)	98 (73.0%)	6 (16.6%)
Scanning documents	1 (0.4%)	--	1 (0.8%)	--
Scheduling	--	--	--	--
Insufficient information	105 (37.1%)	61 (54.0%)	20 (15.0%)	24 (66.7%)
Total	283 (100%)	113 (100%)	134 (100%)	36 (100%)

Table 6: Laboratory Frequency Counts and Percentages for Whether a HIT Wrong-Patient Error Did or Did not Reach the Patient by the Clinical Process Step in Which It Occurred and Was Discovered

	Laboratory			
	All	Reached Patient	Did Not Reach Patient	Insufficient Information
Error Occurred				
Before or during imaging	--	--	--	--
Before or during labs	37 (15.4%)	11 (18.0%)	11 (16.7%)	15 (13.1%)
Before or during medication administration	--	--	--	--
Before or during procedure	--	--	--	--
Dispensing medication	--	--	--	--
Documentation	5 (2.1%)	1 (1.7%)	2 (3.0%)	2 (1.8%)
Inputting results	40 (16.6%)	6 (9.8%)	7 (10.6%)	27 (23.7%)
Labeling	8 (3.3%)	3 (4.9%)	4 (6.1%)	1 (0.9%)
Other	--	--	--	--
Patient engagement	--	--	--	--
Prescribing/ordering	94 (39.0%)	31 (50.8%)	29 (43.9%)	34 (29.8%)
Registration	43 (17.8%)	8 (13.1%)	7 (10.6%)	28 (24.5%)
Review of results	--	--	--	--
Reviewing information	1 (0.4%)		1 (1.5%)	--
Scanning documents	7 (2.9%)	1 (1.7%)	2 (3.0%)	4 (3.5%)
Scheduling	1 (0.4%)			1 (0.9%)
Insufficient information	5 (2.1%)		3 (4.6%)	2 (1.8%)
Total	241 (100%)	61 (100%)	66 (100%)	114 (100%)
Error Discovered				
Before or during imaging	--	--	--	--
Before or during labs	15 (6.2%)	3 (4.9%)	9 (13.7%)	3 (2.6%)
Before or during medication administration	--	--	--	--
Before or during procedure	--	--	--	--
Dispensing medication	--	--	--	--
Documentation	1 (0.4%)	--	1 (1.5%)	--
Inputting results	1 (0.4%)	--	1 (1.5%)	--
Labeling	2 (0.8%)	--	2 (3.0%)	--
Other	--	--	--	--
Patient engagement	9 (3.7%)	6 (9.8%)	3 (4.6%)	--
Prescribing/ordering	4 (1.7%)	1 (1.7%)	2 (3.0%)	1 (0.9%)
Registration			--	
Review of results	64 (26.6%)	20 (32.8%)	18 (27.3%)	26 (22.8%)
Reviewing information	30 (12.4%)	8 (13.1%)	14 (21.2%)	8 (7.0%)
Scanning documents	1 (0.4%)	--	--	1 (0.9%)
Scheduling	--	--	--	--
Insufficient information	114 (47.3%)	23 (37.7%)	16 (24.2%)	75 (65.8%)
Total	241 (100%)	61 (100%)	66 (100%)	114 (100%)

Table 7: Procedure Frequency Counts and Percentages for Whether a HIT Wrong-Patient Error Did or Did not Reach the Patient by the Clinical Process Step in Which It Occurred and Was Discovered

	Procedure			
	All	Reached Patient	Did Not Reach Patient	Insufficient Information
Error Occurred				
Before or during imaging	--	--	--	--
Before or during labs	--	--	--	--
Before or during medication administration	--	--	--	--
Before or during procedure	82 (36.6%)	9 (39.1%)	21 (27.6%)	52 (41.6%)
Dispensing medication	--	--	--	--
Documentation	17 (7.6%)	--	6 (7.9%)	11 (8.8%)
Inputting results	17 (7.6%)	2 (8.7%)	4 (5.3%)	11 (8.8%)
Labeling	5 (2.2%)	2 (8.7%)	2 (2.6%)	1 (0.8%)
Other	2 (0.9%)	--	1 (1.3%)	1 (0.8%)
Patient engagement	--	--	--	--
Prescribing/ordering	38 (17.0%)	3 (13.0%)	25 (32.9%)	10 (8.0%)
Registration	16 (7.1%)	3 (13.0%)	3 (4.0%)	10 (8.0%)
Review of results	1 (0.4%)	1 (4.4%)	--	--
Reviewing information	--	--	--	--
Scanning documents	34 (15.2%)	1 (4.4%)	9 (11.8%)	24 (19.2%)
Scheduling	8 (3.6%)	2 (8.7%)	4 (5.3%)	2 (1.6%)
Insufficient information	4 (1.8%)	--	1 (1.3%)	3 (2.4%)
Total	224 (100%)	23 (100%)	76 (100%)	125 (100%)
Error Discovered				
Before or during imaging	--	--	--	--
Before or during labs	--	--	--	--
Before or during medication administration	--	--	--	--
Before or during procedure	19 (8.5%)	2 (8.7%)	14 (18.4%)	3 (2.4%)
Dispensing medication	--	--	--	--
Documentation	3 (1.3%)	--	2 (2.6%)	1 (0.8%)
Inputting results	--	--	--	--
Labeling	--	--	--	--
Other	--	--	--	--
Patient engagement	5 (2.2%)	4 (17.4%)	--	1 (0.8%)
Prescribing/ordering	3 (1.3%)	--	3 (4.0%)	--
Registration	3 (1.3%)	--	3 (4.0%)	--
Review of results	20 (8.9%)	2 (8.7%)	5 (6.6%)	13 (10.4%)
Reviewing information	60 (26.8%)	3 (13.0%)	34 (44.7%)	23 (18.4%)
Scanning documents	--	--	--	--
Scheduling	--	--	--	--
Insufficient information	111 (49.6%)	12 (52.2%)	15 (19.7%)	84 (67.2%)
Total	224 (100%)	23 (100%)	76 (100%)	125 (100%)

Improving HIT to Reduce Wrong-Patient Errors

In addition to improving clinical processes to reduce wrong-patient errors, there is also an opportunity to improve the design of HIT systems. Additional applied research is needed to identify effective solutions and we recommend the following areas for further exploration:

- Previous research has found HIT safeguards alerting clinicians of potential wrong-patient errors during the ordering process can assist with discovering these errors before reaching the patient.²³ Thus, we recommend further exploring such protection measures to integrate into other workflow processes, such as selecting a patient from a worklist prior to performing a procedure.
- Factors related to clinical working environments, such as lighting, noise, and time pressures, are also important to consider in the context of wrong-patient errors.³⁹ For example, poor lighting, inadequate space, and high noise levels have been associated with medication errors in previous literature.^{40,41} Taking these factors into consideration when designing HIT may reduce the occurrence of wrong-patient errors.
- Several studies have shown that design interventions of HIT, such as making patient facial photographs visible to a provider during the ordering process, have been found to be effective in reducing the occurrence of these errors.^{18,22,29} We recommend incorporating such designs in combination with other strategies, including improvements to the working environment and verbal communication.

Limitations

PSE reports provide one lens for examining the safety hazards in healthcare facilities and are recognized as being underreported. Reporting is influenced by an organization's event reporting culture and ease of reporting, as well as other factors. It is likely that not all HIT wrong-patient events that occurred were reported.⁴² Additionally, when entering reports, the reporter is not required to specify clinical process steps in which an error occurred, was discovered, or how it was caught, resulting in only a subset of reports having this information. It is also worth noting that while the descriptive analysis showed there was only one report with harm, this may underrepresent the actual number of reports that resulted in harm; the reporter may not have known the severity of the event at the time the report was entered.

Conclusion

HIT wrong-patient errors continue to occur across different general care processes and can have serious patient safety consequences. Identifying clinical process steps that are serving to catch errors before they reach the patient can provide additional insight into ways to prevent these errors from harming patients.

Institutional Review Board: This study was approved by the MedStar Health Research Institute institutional review board.

References

1. Buntin M, Burke M, Hoaglin M, Blumenthal D. The benefits of health information technology: A review of the recent literature shows predominantly positive results. *Health Aff.* 2011;30(3):464-471.
2. King J, Patel V, Jammoom E, Furukawa M. Clinical benefits of electronic health record use: National findings. *Health Serv Res.* 2014;49(1):392-404.
3. Committee on Patient Safety and Health Information Technology; Institute of Medicine. In: *Health IT and Patient Safety: Building Safer Systems for Better Care*. Washington (DC): National Academies Press (US); 2012.
4. Ash J, Berg M, Coeiera E. Some unintended consequences of information technology in health care: The nature of patient care information system-related errors. *J Am Med Inform Assoc.* 2004;11(2):104-112.
5. The Joint Commission. Two Patient Identifies - Understanding The Requirements. <https://www.jointcommission.org/en/standards/standard-faqs/home-care/national-patient-safety-goals-npsg/000001545/>. Published 2020. Accessed July 14, 2020.
6. ECRI Institute PSO. *ECRI Institute PSO Deep Dive: Patient Identification*. Plymouth Meeting, PA: ECRI Institute;2016.
7. ECRI Institute. *Patient Identification Errors*. 2016.
8. Partnership for Health IT Patient Safety. Health IT Safe Practices: Toolkit for the Safe Use of Health IT for Patient Identification. ECRI Institute. https://www.ecri.org/Resources/HIT/Patient%20ID/Patient_Identification_Toolkit_final.pdf. Published 2017. Accessed July 14, 2020.
9. Partnership for Health IT Patient Safety. Recommendations & Implementation Strategies: Safe Use of Health IT for Patient Identification. ECRI Institute. <https://assets.ecri.org/PDF/HIT-Partnership/ECRI-Implementation-Guide-Patient-Id.pdf>. Published 2019. Accessed July 14, 2020.
10. Fortman E, Hettinger A, Howe J, et al. Varying rates of patient identity verification when using computerized provider order entry. *J Am Med Inform Assoc.* 2020;27(6):924-928.
11. ECRI Institute PSO. Wrong-record, wrong-data errors with health IT systems. *PSO Navigator.* 2015;7(2):1-10.
12. Kern-Goldberger A, Adelman J, Applebaum J, Manzano W, Goffman D. Wrong-patient ordering errors in peripartum mother-newborn pairs: A unique patient-safety challenge in obstetrics. *Obstet Gynecol.* 2020;136(1):161-166.
13. van der Schaaf T. Medical applications of industrial safety science. *Qual Saf Health Care.* 2002;11(3):205-206.
14. McNab D, Bowie P, Mirrison J, Ross A. Understanding patient safety performance and educational needs using the 'Safety-II' approach for complex systems. *Educ Prim Care.* 2016;27(6):443-450.
15. Anderson J, Ross A, Back J, et al. Implementing resilience engineering for healthcare quality improvement using the CARE model: A feasibility study protocol. *Pilot Feasibility Stud.* 2016;2(1):1-9.
16. Pennsylvania Patient Safety Advisory. Applying the universal protocol to improve patient safety in radiology. *Pennsylvania Patient Safety Advisory.* 2011;8:63-70.
17. Hammerling J. A review of medical errors in laboratory diagnostics and where we are today. *Lab Med.* 2012;43(2):41-44.
18. Hickman T, Quist A, Salazar A, et al. Outpatient CPOE orders

discontinued due to 'erroneous entry': Prospective survey of prescribers' explanation for errors. *BMJ Qual Saf*. 2018;27(4):293-298.

19. Adelman J, Kalkut G, Schechter C, et al. Understanding and preventing wrong-patient electronic orders: A randomized controlled trial. *J Am Med Inform Assoc*. 2013;20(2):305-310.

20. Adelman J, Aschner J, Schechter C, et al. Evaluating serial strategies for preventing wrong-patient orders in the NICU. *Official Journal of the American Academy of Pediatrics*. 2017;139(5):e20162863.

21. Green R, Hripcsak G, Salmasian H, et al. Intercepting wrong-patient orders in a computerized provider order entry system. *Ann Emerg Med*. 2015;65(6):679-686.

22. Hyman D, Laire M, Redmond D, Kaplan D. The use of patient pictures and verification screens to reduce computerized provider order entry errors. *Pediatrics*. 2012;130(1):e211-e219.

23. Galanter W, Falck S, Burns M, Laragh M, Lambert B. Indication-based prescribing prevents wrong-patient medication errors in computerized provider order entry (CPOE). *J Am Med Inform Assoc*. 2013;20(3):477-481.

24. Galanter W, Hier D, Jao C, Sarnea D. Computerized physician order entry of medications and clinical decision support can improve problem list documentation compliance. *Int J Med Inform*. 2010;79:332-338.

25. Wetterneck T, Walker J, Blosky M, et al. Factors contributing to an increase in duplicate medication order errors after CPOE implementation. *J Am Med Inform Assoc*. 2011;18(6):774-782.

26. Adelman J, Applebaum J, Schechter C, et al. Effects of restriction of the number of concurrently open records in an electronic health record on wrong-patient order errors: A randomized clinical trial. *J Am Med Assoc*. 2019;321(18):1780-1787.

27. Kannampallil T, Manning J, Chestek D, et al. Effect of number of open charts on intercepted wrong-patient medication orders in an emergency department. *J Am Med Inform Assoc*. 2018;25(6):739-743.

28. Canfield C, Udeh C, Blonskey H, Hamilton A, Fertel B. Limiting the number of open charts does not impact wrong patient order entry in the emergency department. *JACEP*. 2020;1-7.

29. Tridandapani S, Ramamurthy S, Provenza J, Obuchowski N, Evanoff M, Bhatti P. A multiobserver study of the effects of including point-of-care patient photographs with portable radiography: A means to detect wrong-patient errors. *Acad Radiol*. 2014;21(8):1038-1047.

30. Gibney B, Ryan J, MacMahon P, O'Connor G, Bolster F. Assessment of radiopaque patient identification stickers (RAPIDS) for patient-scan correlation in a mass casualty incident. *Emerg Radiol*. 2020;27:293-301.

31. Harkanen M, Tiainen M, Haatainen K. Wrong-patient incidents during medication administrations. *J Clin Nurs*. 2017;27(3-4):715-724.

32. Koppel R, Wetterneck T, Telles J, Karsh B. Workarounds to barcode medication administration systems: Their occurrences, causes, and threats to patient safety. *J Am Med Inform Assoc*. 2008;15(4):408-423.

33. Henneman P, Marquard J, Donald L, et al. Barcode verification: Reducing but not eliminating medication errors. *J Nurs Adm*. 2012;42(12):562-566.

34. Yamamoto L, Kanemori J. Comparing errors in ED computer-assisted vs conventional pediatric drug dosing and administration. *Am J Emerg Med*. 2010;28:588-592.

35. Fong A, Adams K, Gaunt M, Howe J, Kellogg K, Ratwani R. Identifying health information technology related safety event reports from patient safety event report databases. *J Biomed Inform*. 2018;86:135-142.

36. Strauss A, Corbin J. Grounded theory methodology. *Handbook of Qualitative Research* 1994;17(1):273-285.

37. Noble D, Pronovost P. Underreporting of patient safety incidents reduces health care's ability to quantify and accurately measure harm reduction. *J Patient Saf*. 2010;6(4):247-250.

38. Ratwani R, Fong A, Puthumana J, Hettinger A. Emergency physician use of cognitive strategies to manage interruptions. *Ann Emerg Med*. 2017;70(5):683-687.

39. Dekker S. *The Field Guide to Understanding Human Error*. Brookfield, VT: Ashgate Publishing Company; 2006.

40. Mahmood A, Chaudhury H, Valente M. Nurses' perceptions of how physical environmental affects medication errors in acute care settings. *Appl Nurs Res*. 2011;24(4):229-237.

41. Cohen M. *Medication Errors* 2ed. Washington, DC: American Pharmacist Association; 2007.

42. Jafree S, Zakar R, Zakar M, Fischer F. Nurse perceptions of organizational culture and its association with the culture of error reporting: A case of public sector hospitals in Pakistan Health systems and services in low and middle income settings. *BMC Health Serv Res*. 2016;16(1):1-13.

About the Authors

Tracy Kim (tracy.c.kim@medstar.net) is a research and program coordinator at the MedStar Health National Center for Human Factors in Healthcare.

Jessica Howe is a research scientist and system safety specialist at the MedStar Health National Center for Human Factors in Healthcare.

Ella Franklin is the nursing director at the MedStar Health National Center for Human Factors in Healthcare.

Seth Krevat is assistant vice president for Safety at MedStar Health and a faculty associate at the MedStar Health National Center for Human Factors in Healthcare.

Rebecca Jones is director of Data Science and Research at the Patient Safety Authority (PSA) and founder and director of the PSA's Center of Excellence for Improving Diagnosis.

Katharine Adams is a data scientist with the MedStar Health National Center for Human Factors in Healthcare.

Allan Fong is a senior research scientist with the MedStar Health National Center for Human Factors in Healthcare.

Jessica Oaks is a program manager at the Patient Safety Authority.

Raj Ratwani is the director of the MedStar Health National Center for Human Factors in Healthcare, vice president of Scientific Affairs at the MedStar Health Research Institute, and an associate professor at Georgetown University School of Medicine.

This article is published under the Creative Commons Attribution-NonCommercial license.

