The Use of Patient Pictures and Verification Screens to Reduce Computerized Provider Order Entry Errors

**abstract**

**OBJECTIVE:** To determine whether an order verification screen, including a patient photograph, is an effective strategy for reducing the risk that providers will place orders in an unintended patient’s electronic medical record (EMR).

**METHODS:** We describe several changes to the EMR/provider interface and ordering workflow that were implemented as one part of a hospital-wide quality improvement effort to improve patient identification and verification practices. We measured the impact by comparing the number of reported incidents of care being provided to any patient other than for whom it was intended before the intervention, and directly after the intervention.

**RESULTS:** For the year before the interventions described herein, placement of orders in the incorrect patient’s chart was the second most common cause of care being provided to the wrong patient, comprising 24% of the reported errors. In the 15 months after the implementation of an order verification screen with the patient’s photo centrally placed on the screen, no patient whose picture was in the EMR was reported to have received unintended care based on erroneous order placement in his or her chart.

**CONCLUSIONS:** The incorporation of patient pictures within a computerized order entry verification process is an effective strategy for reducing the risk that erroneous placement of orders in a patient’s EMR will result in unintended care being provided to an incorrect patient.

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**KEY WORDS**
computerized physician order entry, patient identification, electronic medical record, adverse events, national patient safety goals, joint commission, patient safety, medication administration, just culture

**ABBREVIATIONS**
EMR—electronic medical record
ID—identification

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Problems with patient misidentification resulting in care being provided to the wrong patient have been recognized in health care for decades, and are the focus of the Joint Commission’s National Patient Safety Goal No. 1.1 Despite many years of attention, inconsistent practices among and across different staff roles, risk-taking behaviors among staff, and communication barriers were among a list of ongoing challenges identified in a recent qualitative study of resident physician and nurse perspectives on the challenges in eliminating these errors.2 Risk-taking behaviors include situations where staff members fail to follow policies designed to limit errors in care; for example, failing to check 2 patient identifiers before administering a medication. The role of the electronic medical record (EMR) and computerized order entry systems, and their impact on patient identification (ID) errors has, to our knowledge, not been well studied. Henneman et al3 described the lack of patient verification during provider order entry and found that providers infrequently caught patient ID errors. Wilcox et al4 reported on “patient-note mismatches” estimating a prevalence rate of clinical note mismatches for 1 patient entered in a different patient’s electronic medical record of 0.3%–0.5%. They estimated that only 10% of errors of this type were independently recognized by providers and corrected. No other description of the extent of risk or errors of this type was identified in our literature search. We are aware that specific disciplines, especially behavioral health programs (including our own) and substance abuse clinics, particularly methadone replacement programs, routinely use patient pictures in their patient populations for purposes of positive ID. We were unable to locate in our literature review any descriptive use of patient photographs in the EMR as an explicit strategy for reducing ordering errors related to patient ID.

As a result of a number of errors and near-miss events reported in our hospital several years ago, our organization prioritized improvement in patient ID practices among its “top-level” quality improvement pillar goals during the past 2 calendar years (2010–2011). These pillar goals are an essential element in the annual performance evaluation for staff and leadership in our organization. Starting in mid-2009, once we anticipated setting an improvement goal in 2010, broad efforts were made to encourage staff to report any and all errors and near misses specifically related to patient ID. By doing so, we hoped to establish a valid baseline from which to measure reductions in error.

The purpose of this quality improvement effort was to reduce the number of incidents of care provided to patients other than for whom it was intended, by 20% in the first year with a 5-year goal of eliminating these errors. We expected to do this through the use of targeted interventions, as well as broad cultural change focused on reliable, best practices in the use of 2 patient identifiers. The project was reviewed and approved as not being human subjects research by the Colorado multi-institutional review board in January 2010.

This article describes our efforts to improve the accuracy of computerized order entry, focusing specifically on how we have reduced erroneous orders being placed in the wrong patient’s chart through the incorporation of patient pictures and a verification screen during the ordering sequence. It documents the interventions we implemented and their impact on reported errors, and is written in accordance with the Standards for Quality Improvement Reporting Excellence guidelines.5

**METHODS**

**Setting**

Children’s Hospital Colorado is a 318-bed freestanding, tertiary care teaching hospital with 16 network-of-care locations throughout the state and with regional presence in surrounding states. We have ~500,000 outpatient visits and 50,000 emergency department visits annually and admit 13,500 patients, resulting in more than 75,000 inpatient days to our facilities. We were the first children’s hospital in the country to fully implement a single EMR (Epic, Epic Systems, Madison, WI) throughout the continuum of care and have used the system for both clinical documentation and provider order entry since 2007. Our EMR is deployed throughout our network and is also in place in 8 independent but affiliated primary care pediatric practices containing 64 pediatric providers.

**Project Design**

A project team was formed in mid 2009 that was composed of physicians, nurses, hospital leadership, quality and patient safety improvement staff, representatives from clinical and ancillary departments across the organization, including information technology, and 2 family member representatives. A smaller core team met weekly to review data, coordinate initiatives, and generally oversee the execution of numerous project initiatives. These initiatives included review and modification of hospital policies, auditing of wrist band presence and use, changes in staff practices with respect to wrist band use, education of staff regarding best practices, and review of reported errors and near misses to identify system risks and opportunities for intervention.

Staff and providers voluntarily report incidents of any harm, errors, near misses, and variances into a system we call the Quality and Safety Reporting System (RL Solutions, Ontario, Canada). The person reporting the event categorizes each entry in a number of ways, including location, impact, and type of error. Although this person may or may not code a case as a patient ID error,
Each entry is subsequently reviewed by a member of the patient safety team and by a local reviewer in the department responsible for the event. Each case in which a patient ID error or near miss is thought to have occurred is reviewed by a member of the improvement project team for further analysis and categorization.

In the first months of this improvement project, we identified, to our surprise, that one of the highest frequency causes of patients receiving care not intended for them was the erroneous placement of either orders or clinical information (e.g., temperature) in the wrong patient’s chart. This specific type of error has not been systematically described previously to our knowledge, although a literature search did identify 2 related studies. One prospective simulation study found, using an eye-tracking device, that medical providers during the computerized order entry process often miss patient ID errors (97%) and only infrequently verify patient ID before ordering tests (23%). A second study found that 0.3%–0.5% of clinical notes are placed in a mismatched electronic health record. We believe that computerized physician order entry systems introduce this new and unintended source of patient ID errors into the care system.

Figure 1 summarizes the primary types of ID errors reported at our hospital during the first year of the improvement effort (2010). Although bedside errors related to wrong patients having a medication administered to them or a laboratory test performed on them were the most common type of error, fully 24% (12/51) were a result of medication or test orders being placed in the wrong patient’s electronic chart. Furthermore, near-miss data suggested that at least 75% of errors related to orders in the incorrect chart were actually being caught by nursing staff or pharmacists on review of those misplaced orders, and these were then corrected once identified, before being executed. During 2010, 33 near misses of this type were voluntarily reported, almost 3 times the number of actual events that reached the patient. These errors are most likely to be caught when the medications or tests ordered are not consistent with the child’s care plan, symptoms, or diagnosis, and the nursing or pharmacy staff question the ordering provider. It is interesting that Wilcox et al. estimated that only 10% of patient-note mismatches are recognized and corrected, likely owing to the fact that unlike orders, notes do not necessarily require subsequent action by another caregiver.

As the prevalence of this type of ordering error became apparent, the project team established an explicit new goal to reduce their frequency. The team worked with staff in our information technology...
department to identify strategies that could reduce the risk of providers placing orders in an incorrect chart. A number of strategies were considered, including restricting the number of open records any provider could keep in his or her workspace (currently 4). Figure 2 illustrates the view a provider had when more than 1 patient record was open in the user workspace. We were technically unable to determine whether there was any link between the reported errors and multiple records having been open. In the absence of such evidence, and staff concern about workflow if they had to close charts any time they needed to look at another patient’s record, we sought an alternate intervention strategy.

Beginning in the fall of 2010, the computerized order entry workflow was modified to include an order verification screen (Fig 3) that asked the provider to confirm that he or she was placing orders on the intended patient before signing those orders. Soon thereafter, we began taking pictures of hospital patients at admission/registration points, and placing that image on the order verification screen (Fig 4). Additional changes were made to the text of the order verification pop-up screen to highlight key information. Throughout 2011, digital cameras and processes for capturing patient photos were deployed and implemented across the hospital system and by year’s end, reports demonstrated that ∼95% of each day’s inpatients had pictures in their chart.

RESULTS

In 2010, hospital staff reported a total of 51 episodes of care being provided to the incorrect patient. In 2011, the total number of reported patient ID errors of any cause decreased by 25% to 37, and the distribution of the types of errors shifted, with two-thirds of them a result of failure to match medications to the patient at the bedside/point of care (Fig 5).

In the period since the initiation of the order verification screen and the added facial image, reports of errant placement of orders in an unintended patient’s chart have dramatically decreased. In 2011, only 3 patients were reported to have received care not intended for them because of misplaced orders, as compared with 12 such events in 2010. Of note, in none of those 3 instances was the patient’s picture present in the record. Furthermore, 10 near-miss events were reported during 2011, in which
orders were placed on the wrong patient but interrupted by another staff member who questioned the indication for the order, as compared with 33 similar near-miss reports during 2010. Similarly, only 1 of those 10 patients had his or her picture in the record. From a raw (numerator) perspective, these represent dramatic decreases from the previous year. Table 1 compares these data from both raw and rate per adjusted patient day perspectives. Using either methodology, there has been an ~75% decrease in ordering errors resulting in unintended care being provided to the wrong patient since the introduction of this workflow interruption. Early in 2012, one additional error was reported, a medication order incorrectly placed in an unintended patient’s record in an urgent care/ED environment. This was the first time in more than fifteen months that any patient with a picture in his/her record was reported to have received unintended care due to an order entry error.

These results suggest a trend toward a decrease in the frequency of providers erroneously completing orders in the incorrect record after these 2 interventions. Two statistical process control charts (“t-charts”) depict the number of days between reported occurrences of patients receiving care not intended for them because of the placement of an order in the incorrect patient’s EMR. Figure 6 demonstrates the trend for errors resulting in unintended care for patients following the implementation of the order verification screen, including cases both with or without a picture present in the record. The mean days between such events has

![FIGURE 4](image)

Screen shot in the EMR with the patient verification screen (with a photo). Not a real patient.

![FIGURE 5](image)

Reported patient ID events in 2011 by type. (Data reported in the Quality and Safety Reporting System [RL Solutions].)
increased from 21.7 to 82.3 days before and after the order verification screen was introduced, and the two of three points (circled) near the upper control limit suggest the occurrence of special cause variation. Figure 7 reflects the time between order entry errors only if the patient who received unintended care did have a picture in the medical record (after November 2010). This statistical process control chart clearly demonstrates such special cause variation. It is significant that following the introduction of patient pictures, no patient whose picture was in the EMR was reported to have received unintended care based on erroneous order placement in his or her chart for more than 450 days.

**DISCUSSION**

The aim for this improvement effort was to reduce the risk and frequency of providers entering orders in the incorrect patient’s medical record. The intervention was an interruption in the ordering sequence that requires the ordering provider to verify the patient’s identity, a step that is strengthened by having the patient’s picture on the verification screen. This process change did occur during a broad organizational effort to improve patient ID practices across the hospital. The interventions were not designed so as to be evaluable as independent variables. It is also unfortunately not technically possible for us to determine how many times a provider reached the picture/verification screen and abandoned the order having found himself or herself in the wrong record, which would further support the impact of this intervention. Still, it seems likely that this change in the ordering process has been the primary driver of the significant reductions in this type of error given the limited reductions seen in other types of patient ID errors and the continued steady rates of near-miss and error reporting during the project period. Our results are also consistent with those reported by Wilcox et al in which a “pop-up” verification screen (without photograph) was implemented and reduced patient-note mismatches by 40%.

The number of times that errors of this type occurred in 1 year in 1 hospital may seem surprising. We believe that near-miss and no-harm errors of patient ID are an underrecognized and under-reported phenomenon. Our staff has been willing to self-report on numerous occasions in the context of a culture that increasingly seeks to follow principles of a “just culture.”

The placement of orders in the wrong patient’s chart has not been well documented or analyzed as a cause of error, and is potentially enabled by the implementation of computerized physician order entry. Fortunately, none of the reported errors in our hospital have resulted in significant harm to our

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<th>TABLE 1</th>
<th>Patients Receiving Care Not Intended for Them Because of Erroneous Chart Orders</th>
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| Raw Number of Ordering Errors | Rate per 1000
| (Orders on Incorrect Patient Chart) | Adjusted Patient Days |
| 2010 | 12 | 0.09 |
| 2011 | 3 | 0.02 |
| % Reduction from 2010 to 2011 | 75% | 77.8% |

Adjusted Patient Days is a calculated metric that considers both inpatient days and ambulatory encounters to create a standardized measure of overall service volume against which patient ID errors can be assessed.

**FIGURE 6**

The t-chart: Days between Patient ID ordering error events.
patients over the past several years, but they remain a latent systemic risk and we continue evaluating and responding to them as potential causes of serious harm in the future.

Some issues that have been raised related to the use of patient photographs include potential Health Information Portability and Accountability Act concerns (none that we have identified) and the need for updating the picture with changes in the child’s appearance. Our policy is that pictures should be updated annually or at any time the staff feels a change in appearance warrants updating the picture. Workflow at registration has been a concern raised by staff, especially in busy outpatient areas, but we have thus far been able to incorporate picture taking into their processes without significantly affecting efficiency. The scope of work required to implement the order verification screen and patient pictures in the electronic record was extensive and we have encountered various system interface issues with EMR upgrades. Finally, one must also consider the operational expense of placing digital cameras at all entry points to the organization. Even with these considerations, we ultimately believe that the safety benefits and patient centeredness of placing pictures in the medical record outweigh any time pressure or cost issues.

It is well documented in the literature that providers override between 49% and 96% of alerts presented to them in the course of entering orders in the EMR. Unlike other alerts in our own system (which are ignored up to 80% of the time at our hospital), providers report that the large, centrally placed patient picture on the verification screen is effective in capturing their attention when the picture is not of the child they are expecting. This does of course have limitations, especially with newborn babies or when the picture is poorly exposed. We are encouraged by the results of placing patient pictures in the electronic record and presenting providers with that picture when they sign their orders. We are implementing a number of other clinical decision support advisories and alerts in our system and are mindful of the risk of “alert fatigue” where providers do not fully attend to yellow boxes advising of a best practice that may be relevant for their patient. The picture of the patient, however, appears to affect providers differently from a human factors perspective and this would likely benefit from further study. It raises the question of what might we do with other alerts that can be configured to similarly affect providers in the way they are reportedly affected by seeing a patient picture.

**FIGURE 7**
The t-chart: Days between patient ID events, verification screen and picture present.
The most significant limitation of this project is its reliance on voluntary reporting of events that are recognized, as well as the possibility of unrecognized occurrences resulting in errors, events, and near misses. There is no reason to believe that either of these variables has changed over the course of this project. We have seen a marked increase in the average number of events reported into the system, from \( \sim 200 \) per month to more than 800 per month since 2007 (Fig 8). Although there has been a slight fall in reporting since it peaked in Quarter 1, 2010, the reduction is not significant and is unlikely to be the explanation for the improved results we have experienced. The decrease in events observed is much more likely attributable to the intervention than it is to changes in the frequency of error reporting. We would also note as a limitation our ability to discern the differential impact between interrupting workflow using an order verification screen by itself as compared with one including a patient picture. The up-front costs for hardware and ongoing costs in time to place patient pictures are not insignificant; we would encourage other organizations to systematically study this question. It is notable that during 2011 all three cases in which order entry in the wrong patient’s chart resulted in unintended care occurred in patients whose picture was not in the medical record. Furthermore, nurses in ten additional cases recognized and reported that orders had been placed in the wrong patient’s chart and interrupted the order; in only one of those ten cases was the patient’s picture in the record. We will need to continue monitoring for patient ID errors of all types as we continue efforts to reduce ordering errors. We have recently implemented bedside bar code medication administration, completely changing the process of ensuring proper patient ID and medication matching at the bedside. The attitude of “I know my patient” continues to represent a risk to our systems of care delivery and to the patients we are serving. Information system and other technological interventions represent important potential strategies to reduce these types of patient safety risks, but also create unintended risks that must be recognized, analyzed, and addressed.

CONCLUSIONS

We conclude that an order verification screen, including the patient’s photograph, placed before the final signing of orders, is an effective strategy for reducing the risk that orders will be placed in an unintended patient’s EMR. We encourage others who are implementing the use of pictures in the medical record to similarly evaluate the impact on patient ID errors, as we will continue to study our results in Colorado.

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