
Providers Do Not Verify Patient Identity during Computer Order Entry

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Abstract

Introduction: Improving patient identification (ID), by using two identifiers, is a Joint Commission safety goal. Appropriate identifiers include name, date of birth (DOB), or medical record number (MRN).

Objectives: The objectives were to determine the frequency of verifying patient ID during computerized provider order entry (CPOE).

Methods: This was a prospective study using simulated scenarios with an eye-tracking device. Medical providers were asked to review 10 charts (scenarios), select the patient from a computer alphabetical list, and order tests. Two scenarios had embedded ID errors compared to the computer (incorrect DOB or misspelled last name), and a third had a potential error (second patient on alphabetical list with same last name). Providers were not aware the focus was patient ID. Verifying patient ID was defined as looking at name and either DOB or MRN on the computer.

Results: Twenty-five of 25 providers (100%; 95% confidence interval [CI] = 86% to 100%) selected the correct patient when there was a second patient with the same last name. Two of 25 (8%; 95% CI = 1% to 26%) noted the DOB error; the remaining 23 ordered tests on an incorrect patient. One of 25 (4%, 95% CI = 0% to 20%) noted the last name error; 12 ordered tests on an incorrect patient. No participant (0%, 0/107; 95% CI = 0% to 3%) verified patient ID by looking at MRN prior to selecting a patient from the alphabetical list. Twenty-three percent (45/200; 95% CI = 17% to 29%) verified patient ID prior to ordering tests.

Conclusions: Medical providers often miss ID errors and infrequently verify patient ID with two identifiers during CPOE.

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Keywords: patient identification, computer physician order entry, CPOE, medical errors

Medical errors result in as many as 98,000 deaths annually in the United States, making them the sixth leading cause of death.¹⁻³ Many of these deaths are preventable, and prevention strategies have been recommended.⁴⁻⁷

To reduce the frequency of medical errors, the Joint Commission created national patient safety goals in

2005. One of the goals is to improve the accuracy of patient identification (ID) by using at least two patient identifiers.⁴ Full name, date of birth (DOB), and medical record number (MRN) are considered appropriate patient identifiers. Age, gender, reason for visit, and patient location are not considered appropriate patient identifiers.

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Failure to verify a specific patient's ID can result in errors impacting not only that patient but a second patient as well.^{8,9} First, there is the patient who needs the treatments and tests but does not receive them, and second, there is the patient who has treatments and tests ordered that are not specific to him or her. At a minimum, there is a delay in the care of a patient who needs the treatments and tests. Potentially more serious, inappropriate treatments and tests may be performed on the wrong patient and result in an adverse event or events. The incorrect treatments and interventions may be caught (i.e., a near miss), most often by the patient's nurse, but many are missed.¹⁰⁻¹²

We designed an experiment, using an eye-tracking device, to measure the frequency and accuracy of medical providers in an emergency department (ED) to recognize embedded errors in identity and to verify patient identity by using two identifiers prior to selecting a patient from a computer alphabetical list and prior to ordering tests in a computer order entry system.

METHODS

Study Design

This was a prospective investigation of providers checking patient identities in charts and computer screens using a visual tracking device that showed provider eye movements. The study was approved by the institutional review board of the medical center.

Study Setting and Population

The study was conducted in the ED of a Level 1 trauma, pediatric, and tertiary referral medical center. The ED has an annual census of over 100,000 patients and is staffed by board-certified or board-eligible emergency physicians, physician assistants (PAs), and emergency medicine residents. Computerized provider order entry (CPOE) is used by providers in the ED. All attending physicians, PAs, and upper-level emergency medicine residents (Postgraduate Year 2 and Postgraduate Year 3) were invited to participate. The study was conducted during a 12-hour period on a single day and included shift change from different areas of the ED at 7:30 AM, 9:00 AM, 3:30 PM, and 5:00 PM.

Study Protocol

Providers were told that the purpose of the study was to use an eye-tracking device to evaluate how visual cues were used in the decision-making processes such as ordering tests for patients. They knew that the eye-tracking device recorded the location upon which they were focusing. Providers were not told that the purpose of the study was to evaluate their use of patient identifiers. Providers who participated were asked not to discuss the specifics of the experiment with anyone on the day of the experiment.

After giving providers a half-page description of the study and obtaining informed consent, the eye-tracking device was placed on the participant and calibrated (Figure 1). Participants were asked to look at 16 specific points of reference in their visual field, which allows the device software to then overlay cross hairs (a plus

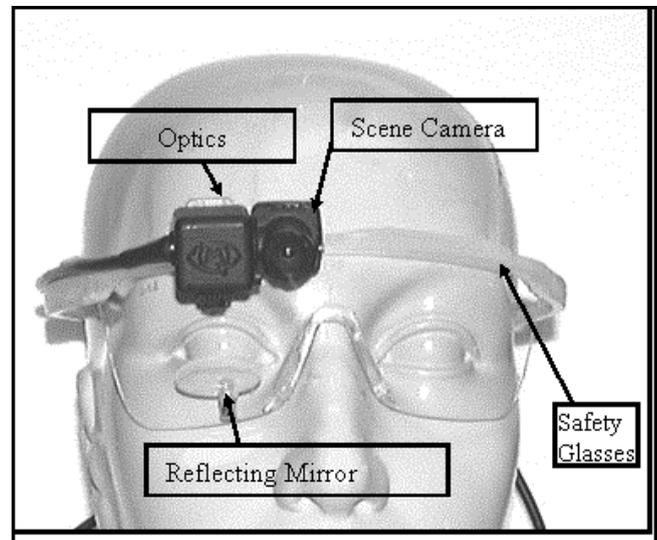


Figure 1. Eye-tracking device (Applied Science Laboratories Mobile Eye).

sign) on the video exactly where the individual was looking at any given moment. After the calibration process, providers were given 10 fictitious nursing triage charts, half with handwritten patient name and DOB and half with typed patient information labels. Triage notes and order sheets on patients who are brought directly into a patient care space without registering only have patient name and DOB written on them. Typed labels that include patient name, DOB, and MRN are created after patient registration and then placed on all parts of a patient's chart. Providers were asked to review each triage note, select the appropriate patient from an alphabetical list in the computer system (alpha screen), and order tests based on the patient's initial complaint (order screen). Both computer screens (alpha and order) contained patient ID information; the alpha screen contained name and MRN, and the order screen contained name, DOB, and MRN. Subjects were asked to imagine that it was a busy day in the ED; these were patients in the waiting room; and they were ordering tests in advance to try to expedite patient care.

Subjects utilized a laptop computer with screen shots of the actual computer images (the screen looked similar to the Cerner Millennium computer screen images used in their practice). Permission was obtained from the Cerner Corp. (Kansas City, MO) to use the screen shots in the experiment. Subjects signed into the dummy hospital computer system on the laptop and called up the simulated alphabetical list of patients in the ED on the alpha screen. The subjects then reviewed each triage chart and selected the patient from the alphabetical list. The same alphabetical list of patients on the alpha screen was used throughout the experiment. Each row of the alpha screen contained information on a patient in specific columns, including his or her last name, first name, age, reason for visit, gender, MRN, primary care physician, and visit time; it did not include DOB. The absence of DOB on the first screen was meant to test

the use of MRN by providers, when it was available (i.e., typed labels). After positioning the cursor over a specific patient's row of information and clicking, a second screen appeared, which was the test-ordering screen. This order screen was used by subjects to order tests of their choosing. Highlighted across the top of this screen were five columns: the first column on the left contained the patient's last and first name; the second column contained his or her age and DOB; the third column contained his or her gender and MRN; the fourth column contained his or her location (ED) and account number; and the fifth column contained whether he or she had allergies. The video recorded all screens utilized and all typed entries. When the video system did not work (e.g., no recording), no data were collected except that by an observer. Specific actions by the providers related to the ID errors were looked for by an observer (i.e., did the observer comment on the ID error; did they select the patient with the ID error in the computer; did they order tests on the patient with the ID error).

A head-mounted camera on the eye-tracking device (ASL Mobile Eye, Applied Science Laboratories, Bedford, MA) recorded a video of the area in front of the subject. The eye-tracking device is first calibrated to each user. The calibration process has subjects look at specific reference points in their field of view. The cross hairs of visual fixation are then adjusted to each of the specific reference points allowing software to overlay cross hairs (a plus sign) on the video designating the particular location in a scene at which the participant was looking. The ASL Mobile Eye is a tetherless eye-tracking system that allows freedom of movement and can be worn by an active participant. Pupil-corneal reflection is used to measure the position of the eye. The eye tracker includes a scene camera, optics, and reflecting mirror all mounted on safety glasses, as shown in Figure 1. The weight is 76 g. The eye position is sampled at 25 Hz. The system is accurate to within 0.5° of visual angle and is capable of a resolution of 0.10° of visual angle; the patient's name, DOB, and MRN were each separated on the computer screen by greater than 2° of visual angle. With the head stable, the visual range of the eye-tracking device is 50° horizontally and 40° vertically. The output is stored on a tape. The tape is analyzed with the Mobile Eye software program, which, after calibration, is able to overlay cross hairs at the exact location in a scene where the individual is gazing at each point in time during the unfolding of a scenario.¹³

If the device is unable to be calibrated to an individual, it will not place cross hairs on the video but will continue to record the general area toward which a person's head is pointing. The eye-tracking device cannot be calibrated to an individual on occasion because the participant's eyes are too light (i.e., the software cannot find the pupil), the participant's own glasses cause significant glare, or the eye lashes are too long (i.e., the infrared light gets scattered). Videos without cross hairs (i.e., not calibrated) were excluded from analysis of what each subject was looking at but still could be used to record the general actions of the subject (e.g., ordering tests).

Of the 10 triage charts, 2 had embedded ID errors (the patient ID information on the triage chart could not be matched exactly with any patient on the computer) and 1 had the potential for error (the patient ID information on the triage chart could be exactly matched with one patient on the computer and closely matched with a second). One patient, with a handwritten name and DOB on the triage chart (no MRN), had a different DOB on the computer order screen (chart: John Andrew, DOB 3/7/59; and computer: John Andrew, DOB 7/3/58; recall the alpha screen did not have the patient's DOB); this chart was always the last patient the subject reviewed. A second patient had a different spelling of her last name on the chart's typed label (Megan Jessie) and on the computer alpha and order screens (Megan Jesse) with the same DOB and MRN. A third chart was of a patient for whom the alphabetical list in the computer of patients in the ED had another patient with the same last name and similar first (i.e., Jessie Torres and Jessica Torres); this was the potential error. Registration errors like those included in our study have been documented in the literature.^{9,14}

Patient complaints on the triage notes ranged from potentially serious to benign. Not all patients had complaints that necessarily warranted early testing in the situational scenarios described to the participants (i.e., ordering tests while the patient was still in the waiting room). The patient with the DOB error, John Andrews, was a 48- (or 49)-year-old man with dull chest pain. The patient with the misspelled last name (Megan Jessie/Jesse) was an afebrile, 32-year-old with asthma, with 2-days of runny nose, cough, and a temperature of 100°F. The two patients with the same last name and similar first name (Jessica/Jessie Torres) were both elder females with altered mental status. The remaining seven scenarios were of patients with common ED complaints.

During the experiment, one of the authors assisted the subjects with their questions, and a second author observed the subjects and recorded which Torres patient they selected and ordered tests on, whether Megan Jessie was selected in the computer, and whether they ordered tests on John Andrews (TP and YM). Subject comments were also written down, including when they verbally communicated a patient ID error (e.g., John Andrews has different DOB or there are two spellings of Megan Jessie/Jesse).

Subject videos with cross hairs (i.e., successfully calibrated) were reviewed independently by two authors (TP, YM) who completed a datasheet that asked specific yes or no questions about whether the subject looked at specific items (the name and MRN on the alphabetical screen and the name, DOB, or MRN on the order screen). On the alphabetical screen, movement of the subject's fixation from the name column to the MRN column was counted as looking at the patient's MRN. On the ordering screen, any placement of cross hairs within a specified box around each of the three key identifiers (i.e., patient name, DOB, MRN) was counted as looking at the target. A third reviewer blinded to the results of the first two reviewers was asked to resolve differences between the first two reviewers. Percentage

agreement between the initial two reviewers was quantified via the kappa statistic. Reviewers were not blinded to which patients in the scenarios had actual or potential ID errors. For the purpose of the study, we assumed that looking at name and MRN prior to selecting the patient from the alphabetical list on the alpha screen, and looking at name and either DOB or MRN prior to ordering tests on the order screen, counted as verifying patient ID. Providers who did not select a patient from the alphabetical list or order tests were not expected to verify patient ID on those computer screens.

To determine the relative frequency of same last name patients in the ED at the same time, daily ED patient lists for 10 days were reviewed by two independent reviewers (RK, PH) as a second supplemental part to this study. Patients with same last names were identified on the alphabetized lists and then checked to see if their stay in the ED overlapped for any time period (i.e., bed placement to leave ED). Different patients from each reviewer’s list were then individually reviewed and a final count of same last name patients in the ED at the same time was made. Percentage agreement between reviewers was quantified via kappa statistics.

Data Analysis

Combinatorial (exact) 95% confidence intervals (CIs) were calculated for binomial responses using Stata/SE 10.0 (Stata Corp., College Station, TX); if the result was a 100 or 0% response, then a one-sided 97.5% CI was calculated.

RESULTS

Twenty-nine emergency medical providers were invited to participate. Twenty-five (86%) agreed to participate, including 9 attending physicians, 5 PAs, and 11 emergency medicine residents (Postgraduate Year 2 and 3). Four providers did not participate, including 2 attending physicians and 2 residents.

Eye-tracking data could not be utilized for 14% (35/250) of scenarios. This was due to failures with the video system (23/250) and failures in the eye-tracking system (12/250).

Results for the two error scenarios by the 25 participants (i.e., 50 participant error scenarios) are listed in Figure 2. For the scenario with the DOB error, 2 of the 25 participants detected the DOB error on the order screen after looking at the ID information and did not

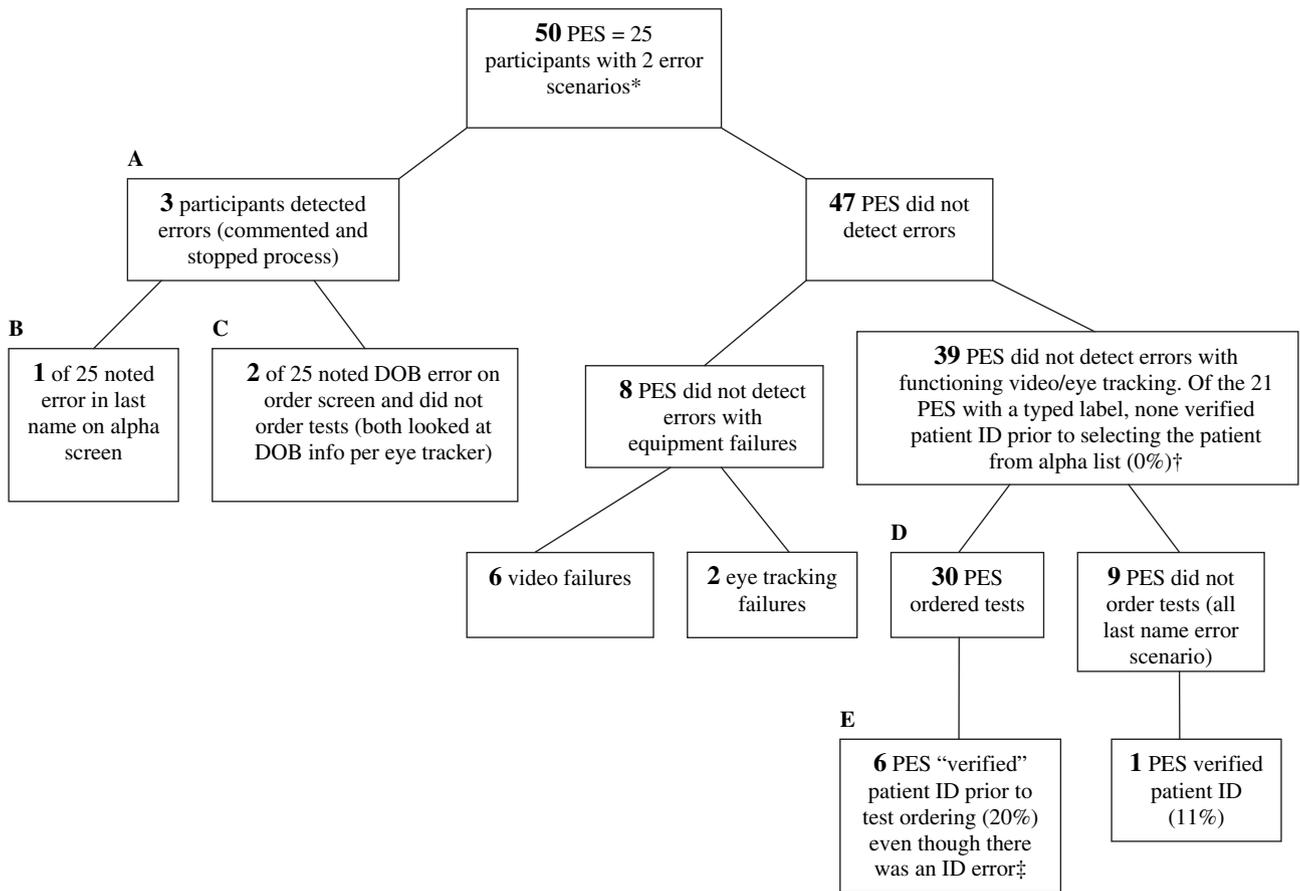


Figure 2. Results for two scenarios with identification (ID) errors. *Error scenarios: 48- (or 49)-year-old with dull chest pain (handwritten label; date of birth [DOB] error) and 32-year-old asthmatic with cough, runny nose, and temperature of 100°F (typed label; last name error). †Patient ID on alpha screen could only be verified for scenario with typed label; verified patient ID was defined as looking at name and MRN. ‡Verify patient ID was defined as looking at name and either DOB or MRN. A–E are boxes referred to under Discussion. DOB = date of birth; PES = participant error scenarios.

order tests (box labeled C on Figure 2). The remaining 23 participants ordered tests as determined by the observer. Eye-tracking data were available on 21 of the participants, including the 2 that detected the DOB error (box C). Nineteen of these participants ordered tests (box D). Of these 19, 4 looked at patient ID information on the order screen but did not detect the different DOB and went ahead and ordered tests on the incorrect patient (included in box E).

Only 1 of the 25 participants detected the error in the spelling of the last name while viewing the alphabetical screen and stopped the process (box labeled B). The remaining 24 participants selected the patient on the alphabetical screen (i.e., missed the last name error and selected an incorrect patient); eye-tracking data were available on 21 of these participants. None of the 21 verified patient ID prior to selecting the patient on the alpha screen (0%; 95% CI = 0% to 16%). Of the 11 participants who ordered tests in this scenario (included in box D), only 2 (18%) verified patient ID by looking at name and either DOB or MRN prior to entering orders, but again missed the difference in spelling of the last name (included in box E).

Overall, for these two error scenarios, only 6% (3/50) of participants detected the ID errors (boxes B and C; 95% CI = 1% to 17%). Of the 30 participant scenarios with ID errors in which orders were placed on the wrong patient and there were eye-tracking data (box D), 20% “verified” patient ID prior to ordering tests (box E, 6/30; 95% CI = 8% to 39%). Overall, in the two error scenarios, only 8 participants verified patient ID on the order screen (i.e., looked at patient name and either DOB or MRN), 2 of whom caught the error (box C) and 6 of whom missed the error (box E), making the

overall accuracy of the process of verifying patient identity in these scenarios only 25% (2/8; 95% CI = 3% to 65%).

Twenty-five of 25 subjects (100%; 95% CI = 86% to 100%) selected the correct patient from the alphabetical screen that included another patient with same last name and similar first name (i.e., Jessie Torres and Jessica Torres). The results of this scenario were combined with the results of the seven other scenarios without ID errors and are shown in Figure 3. Of the 173 patient scenarios without ID errors and with functioning video/eye-tracking equipment (box F), 86 were for scenarios with typed labels. None of the participants verified patient ID prior to selecting the patient with a typed label from the alphabetical screen (0/86; 95% CI = 0% to 4%). Of the 170 participant scenarios without ID errors in which orders were placed and eye-tracking data were available (box G), only 23% (box H) verified patient ID prior to ordering tests (39/170; 95% CI = 17% to 30%).

Overall, in the 107 patient scenarios with typed labels and eye-tracking data, no participant verified patient ID by looking at name and MRN prior to selecting the patients on the alpha screen (0%, 0/107; 95% CI = 0% to 3%). Of the 200 patient scenarios with eye-tracking data in which orders were placed, only 23% (45/200; 95% CI = 17% to 29%) verified patient ID by looking at name and either DOB or MRN prior to ordering tests. Percentage agreement between independent reviewers to determine what patient ID information subjects were looking at was 94% (kappa 0.87; 95% CI = 0.84 to 0.91).

The results of the second, supplemental experiment showed that during a 10-day period in 2007, 2,886 patients were seen in the ED. On the daily patient lists,

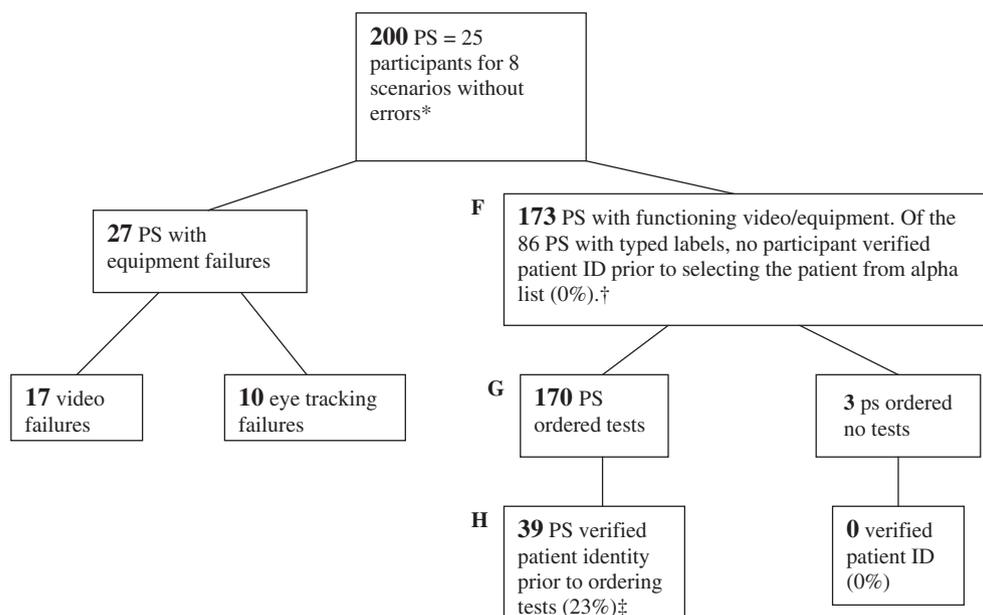


Figure 3. Results for eight scenarios without identification (ID) errors. *Scenarios without errors included four with handwritten labels and four with typed labels. The scenario that had two patients with the same last name on alphabetical list was included as a scenario without error. †Patient ID on alpha screen could only be verified for the four scenarios with typed labels; verified patient ID was defined as looking at name and MRN on alpha screen. ‡Verify patient ID was defined as looking at name and either DOB or MRN on the order screen. F–H are boxes referred to under Discussion. PS = patient scenarios.

there were 664 patients (23%) with the same last name as someone else in the ED on the same day. During the 10-day period, there were 319 patients (11%; 95% CI = 10% to 12%) who were in the ED at least part of the time as another patient with the same last name. There were no patients during the 10-day period in the ED at the same time with the same last name and same DOB. There were only 14 patients (0.5%; 95% CI = 0.3% to 0.8%) in the ED at the same time as someone else with the same DOB. Percentage agreement among the two reviewers reviewing patient lists was 99% (kappa 0.97; 95% CI = 0.96 to 0.99).

DISCUSSION

We found that medical providers often miss patient ID errors during CPOE because they usually do not verify patient identity by checking two patient identifiers prior to selecting the patient from an alphabetical list and prior to ordering tests. We also found that even when providers look at a patient ID error, they often do not recognize it. We know this because an eye-tracking device showed that providers did not look at patient ID information during CPOE and they ordered tests on incorrect patients.

Computerized provider order entry is recommended by the Institute of Medicine.^{5,6} It is considered to be safer than handwritten orders where legibility can be problematic. In addition, the treatments and tests ordered in CPOE can be automatically checked against allergies, patient weight, or recent similar treatments or tests.^{5,6,15,16} The Leapfrog Group, a consortium of large companies, has recommended CPOE as one of the key practices to promote patient safety.⁷ In 2002, approximately 10% of hospitals in the United States reported full availability of CPOE to providers and an additional 6.5% had partial availability.¹⁷

Although CPOE is felt to improve patient safety, it also may cause new errors like the ones we demonstrated.¹⁸⁻²¹ We know that technology can reduce or eliminate certain errors, but it can also introduce the potential for new ones.

Patient verification is critical to accurate and safe clinical care. With each patient interaction, verification of patient ID with two unique identifiers should occur, whether it is when first seeing a patient, finding the medical record, ordering treatments and tests, labeling specimens, giving medications, or performing tests or any medical intervention.

Corrections of the types of errors we saw will need to include provider education, but should also include redesigning the system and processes to minimize or prevent the errors we demonstrated with CPOE.^{5,6,8,9,14} Since humans will always make errors, we need systems and processes that prevent us from making errors, including patient ID errors.^{1,6,7} Radiofrequency ID devices and bar coding have been used in other settings to reduce patient ID errors.^{22,23} In the setting of computer patient selection from an alphabetical list, it is unclear how these technologies might help. In this setting, the actual process may need to be changed, such as delaying the alphabetical list until after a MRN or DOB is first entered, so that only one or a few

patients are on the alphabetical list to select from. The advantage of this process is that it forces the use of two patient identifiers.

The eye-tracking device used in our experiment has been used for over four decades in research on the human-machine interface.²⁴ Eye trackers have proven helpful inside and outside of the health care setting and hold promise to help researchers understand what information is considered by health care providers when making a particular selection.²⁵⁻³⁴

Future research will need to evaluate the frequency and accuracy of the process of verifying patient ID used by other health care workers performing other common patient care tasks that include the process of verifying patient identity. If other health care workers do not verify patient identity with sufficient accuracy, the entire process needs to be reexamined.

In summary, we found that medical providers during CPOE were able to differentiate between two patients with the same last name and similar first name, but were not able to detect an ID error in a patient with a slightly different spelling of their last name or a patient with the same first and last name but different DOB. The failure to detect these identity errors resulted in the providers ordering tests on the incorrect patient.

LIMITATIONS

We studied medical providers from a single institution doing a single process in which there was a need for verification of patient ID twice during the process (i.e., before selecting patient on alphabetical list and before ordering tests). We only tested 25 subjects, making our 95% CI broad; our goal, however, was not to determine the exact percentage of errors, but whether errors in patient ID occurred in the CPOE process and their relative frequency (i.e., common or uncommon). We tested subjects in an experimental setting instead of actual patient care, which may have affected subject performance. It would not be appropriate, however, to introduce ID errors into actual patient care. The video system failed 9% of the time, most often from the video tape running out during an experiment. The eye-tracking device failed 5% of the time due to glare from a participant's glasses and from the camera being inadvertently deviated to the side. Although the video system failed in 14% of the patient scenarios, there was an observer to determine key actions in each scenario with an ID error. The independent reviewers for the eye-tracking device disagreed 6% of the time, requiring a third reviewer to resolve differences. The high percentage of agreement between independent reviewers attests to the reliability of the eye-tracking device.

CONCLUSIONS

Medical providers infrequently verify patient ID and often miss ID errors during computer order entry. Provider education, process changes, and system improvements are needed to improve the accuracy of patient ID during computer order entry.

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Thoughts from My Visit to Salvatore Vicario, MD

I should not have survived the MVC,
 But did with fracture and dislocation.
 I wonder why I was Maker-spared?
 What message am I guided to deliver?
 Sadly, nothing more profound nor
 Philosophically relevant has welled forth
 From my fixation wires than the plea:
 Let's all warm our FAST exam gels!

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