

Electronic Err

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The Case

A 75-year-old woman with coronary artery disease presented to the emergency department (ED) with chest pain that had not responded to three sublingual nitroglycerin tablets at home. Supplemental oxygen and nitroglycerin paste resulted in resolution of the patient's symptoms, but she was admitted for cardiac monitoring and serial cardiac enzymes to rule out myocardial infarction.

The patient gave a clear history to the admitting internist, but could not recall the names of some of her medications, nor could she remember any of the doses. The hospital was able to access the electronic health record (EHR) of the large multi-specialty clinic where the patient received her medical care. The admitting physician printed the medication list from that EHR. The most recent note in her ambulatory chart listed warfarin, aspirin, clopidogrel, diltiazem CR, metoprolol XL, and atorvastatin—so he wrote orders for those medications with doses as stated in the medication list.

One hour later, the admitting physician received a page from the telemetry floor. The nurse informed him that the patient had developed a junctional rhythm with a heart rate less than 40 and stated, "She looks really bad." She was given atropine stat, which resulted in improvement in the heart rate and the patient's general appearance.

On reviewing the patient's outpatient record in greater detail, the physician found a recent cardiology note. The note listed the same medications documented elsewhere in the EHR, but also documented his plan to discontinue diltiazem and decrease metoprolol due to recent episodes of symptomatic bradycardia.

Neither the EHR medication list nor the most recent note from the primary care physician reflected these changes, but a call to the patient's pharmacy confirmed that she had not refilled her diltiazem and that metoprolol had been prescribed at a lower dose than before. Thus, the patient had been given 100 mg of metoprolol XL and 180 mg of diltiazem CR by the hospital admitting physician, rather than the 50 mg of metoprolol XL and no diltiazem intended by her outpatient cardiologist. The patient remained clinically stable, but did rule in for a myocardial infarction with a troponin that peaked at 8. Whether the infarct resulted from the medication error or had already occurred at the time of admission was unclear, but the

physician did inform the patient of the error.

The Institution's Response

After a discussion of this case at the clinic's monthly safety and quality improvement meeting, a physician and nurse audited a small random sample of patient records. Medication lists commonly lagged far behind clinic notes, frequently containing medications no longer received by the patient, omitting new medications, and failing to document changes in dose. Analogous discrepancies were found for problem lists: patients' main EHR problem lists often continued to list problems long since resolved and failed to include new problems.

The clinic approached the EHR vendor to ask about modifications to the current system that would allow automatic updating of medication and problem lists or, in the absence of such a system, add a flag to medication and problem lists indicating that the patient has been seen in clinic more recently than the date of the last change to the medication list. The vendor thought that the latter solution could be implemented over a 6- to 12-month time frame. In the meantime, clinic nurses added a medication review to vital signs and weight prior to each patient's appointment with a physician.

The Commentary

This interesting case raises the question whether use of an electronic health record (EHR) system can create new opportunities for medical error that were not present in the paper system. Errors can arise either because the new technology exposes underlying latent errors that had not been visible previously or the new technology itself introduces opportunities to make mistakes. Errors that result from using the new technology can be caused by the workflow required to use the technology (eg, a cumbersome user interface may cause a user to pick the wrong item; poor methods of presenting data can obscure important information) (1) or from misinterpretation or misuse of the output from the technology.

In this case, the error is one in which the new technology exposes deficiencies in existing record-keeping procedures—the existence of the EHR made the inaccurate information contained in the medical record more readily available. Regardless of whether EHR use exposes deficiencies in the underlying paper system or creates new error opportunities, however, both situations are dangerous to patient care and need to be better understood as the country proceeds in wide-scale implementation of EHR systems.(2)

The medical error, and subsequent adverse event, reported in this case arose when the admitting physician based medication decisions on the content of the medication list contained in the EHR system used by the patient's primary care physician. Unfortunately, a specialist changed the patient's medications and documented the change in the progress note, but did not update the active medication list. Hence, the patient's medical record contained inconsistent information. In the EHR system described, maintenance of the medication list was a manual task, as it is in the paper system. Consequently, the inconsistency could have occurred in either a paper-based medical record or an EHR.

Many of the current comprehensive EHR systems automatically populate the active medication list when electronic prescriptions are written or renewed. When changes to doses are made or a medication is discontinued, however, the physician must actively update the existing medication list.

The accuracy of information contained in paper records has been studied more extensively than the accuracy of data in EHR systems. Results from these studies of paper records have been disturbing. In one study, 40% of encounters had no diagnosis recorded and 30% had no therapeutic agent recorded.⁽³⁾ In another study, up to 49% of the visits did not include a well-defined treatment plan in the record.⁽⁴⁾ Perhaps one reason the status quo has been maintained so long is that the deficiencies have been hidden by the unavailability or illegibility of the paper record.

Although there are fewer studies of the accuracy of information in EHR systems, the results are more encouraging, although still far from ideal. In one study, medication lists were found to be 83% correct and 93% complete.^(5,6) In a study assessing the completeness of medication lists maintained by physicians using an EHR compared with medication lists maintained by physicians using a paper record in the same department, the medication lists in the EHR were judged by a blinded expert panel to be approximately twice as complete as those in the paper record (p7) Regardless of which media is used to store the medication list, its dependence on manual updates when medications are changed leaves room for error. And, as was true in this case, the situation is further complicated when multiple parties are managing a patient's medications.

Methods to encourage physicians to conscientiously maintain up-to-date medication lists have traditionally relied on education and peer pressure. When using an EHR system, several factors can encourage or reward physicians for maintaining summary information such as the active medication list. In an electronic record, one of the main incentives to maintain an accurate summary list is that it allows for instant access to information, something that cannot be replicated in the paper world. Of course, the technology can help facilitate keeping accurate and up-to-date summary lists. For example, in a properly designed EHR, writing an electronic prescription will automatically update the summary medication list. Moreover, the act of writing an electronic prescription can automatically make an entry in the progress note, in contrast to the double entry necessary with paper records.

Although there is a great deal of hope and optimism that more widespread use of EHR systems will significantly improve patient safety, this case should remind all clinicians that having instant access to information does not guarantee its veracity. The traditional best practice of using multiple sources to verify the accuracy of information critical to making key clinical decisions (eg, cross checking summary lists with other sources of information) is still warranted. The advantage of using an EHR system is that more complete information is available anytime. In a blinded expert-panel study assessing medical decisions of physicians using an EHR compared to those of similar physicians using traditional paper records, the experts scored the EHR-supported decisions as significantly more appropriate than those of physicians using a paper record.⁽⁷⁾

Another patient-safety policy that could be incorporated into routine practice with EHR systems would be to produce an up-to-date printout of the current medication list for a patient at the end of each encounter. Creating such a list is a JCAHO requirement for hospital discharge. It makes just as much sense in the outpatient setting, and in our experience at the Palo Alto Medical Foundation, patients greatly appreciate it. This practice has the additional benefit of further motivating physicians to keep patients' medication lists updated.

When implementing EHR tools to improve access to and management of clinical information, it is important not to abandon the safety practices used in the past, but rather to use the richer set of patient safety tools provided by the EHR system to continuously improve the safety performance of the delivery system. The safety practices described in this case study (eg, informing the patient of the error, assessing the root cause of the adverse event, performing a hazard analysis, and developing prevention strategies) indicate that a healthy culture of safety is in place to respond to safety incidents. Use of EHR safety tools will go a long way toward preventing them from occurring in the first place, as espoused by the Institute of Medicine (IOM).⁽⁸⁾

As the country embarks on initiatives to increase the adoption of electronic prescribing and EHR systems, practitioners should keep in mind that these computer systems are merely tools that must be used effectively by physicians to reduce the number of medical errors.

Providers should keep the following priorities in mind when acquiring or using EHR systems:

- Select electronic health record systems that incorporate the IOM's key capabilities ⁽⁹⁾ addressing patient safety and medication safety (eg, drug interaction checking, rule-based alerts, preventive services reminders, and patient access to the EHR).
- Increase physicians' awareness of the benefits of maintaining an accurate medication list, and the liabilities of not doing so, through education and by using case studies such as this one.
- Institute practices to provide patients with an up-to-date list of current medications and instructions after every encounter.
- Continue to use best practice safety techniques (eg, verifying critical patient information) when making key clinical decisions based on information in the medical record.

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