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# EMR Entry Error: Not So Benign

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## The Case

A 47-year-old man with advanced AIDS was admitted to an academic medical center with a chief complaint of shortness of breath. He was diagnosed with *Pneumocystis jiroveci* pneumonia (PCP) and started on appropriate antibiotic therapy. On physical examination, in addition to abnormal pulmonary findings, the patient had multiple flat purple skin lesions on his left thigh and several perianal lesions. Given his advanced AIDS, the medical team was concerned about Kaposi's sarcoma and human papillomavirus (HPV) infection, respectively. The dermatology service was consulted, and they performed biopsies of both lesions.

The patient continued to receive treatment for PCP and was slowly improving. Three days later, the intern on the team was reviewing the patient's clinical information in the hospital's electronic medical record (EMR). She looked up the biopsy results and discovered that the left thigh lesion was Kaposi's sarcoma and the perianal biopsy showed squamous cell carcinoma *in situ*. Interestingly, there was a third biopsy result in the electronic record, labeled "right neck" and reported as "basal cell carcinoma." The intern didn't recall any neck lesions (or discussion of a third biopsy), but questioned her memory as it had been a busy call night. She noted the results and went to see other patients.

The patient's primary care doctor (who was not directly caring for the patient in the hospital) visited the patient and looked at the medical record before seeing him. He noted the PCP diagnosis, a low CD4 count, and biopsy evidence of three separate cancers. Given the patient's end-stage AIDS and these new diagnoses, the primary care doctor met with the patient and recommended hospice care. He told the patient that, with "cancer in three places," his overall prognosis was poor.

That afternoon, the inpatient medical team recognized the error—the neck biopsy had been performed on another patient and accidentally entered into this patient's medical record. The team and the primary care doctor all met with the patient to disclose the mistake, but clearly the error had caused the patient tremendous pain and mental anguish.

On further investigation, it became clear that the dermatopathology department was unaware of the error. Their department used a standalone software program to track and report biopsy results, a system whose results were electronically "dumped" into the hospital's EMR. But the department physicians and staff didn't have access to the hospital's EMR. In fact, when called and asked if they had seen the error in X (the name of the EMR), the pathologist responded, "What is X?" Eventually, it was determined that the third, incorrect biopsy result had been entered into the pathology software under the wrong patient identifier and then uploaded into the hospital's EMR.

## The Commentary

This case is an opportunity to examine patient identification mix-ups within electronic medical records (EMRs) and their impact on patient safety. A naïve view is that this case demonstrates the dangers of EMRs. I argue that the EMR did not fail here. Rather, the errors were in (i) weak linkages *among* computer systems, (ii) insufficient safeguards against patient misidentification, and (iii) poor hospital work-processes and data fragmentation.

The Case for EMRs

Health care providers and systems have been increasingly urged to adopt EMRs. The federal government and many payers seek to subsidize and/or reward physicians' EMR use and to penalize "failure" to use EMRs. These incentives markedly increased recently with the passage of the Obama administration's stimulus package, which set aside $19 billion to promote health care information technology.(1)

Some aspects of this growing emphasis are understandable and justified. EMRs, also called electronic health records (EHRs), offer many benefits. They facilitate:

- Easier and more accurate record keeping and scheduling;
- Automation of lab orders and integration of lab reports;
- Links to pharmacies (including electronic prescribing) and computerized physician order entry (CPOE);
- Chronic disease management tools;
- Integration of decision support systems (DSS)—alerts and reminders for providers to improve the quality of care, reduce medication costs, eliminate redundant tests, and prevent errors;
- Epidemiological analysis of data from targeted or broad populations of patients; and
- Potentially safer and less expensive care.

Despite their many current and potential benefits, EMRs are found in few hospitals or physicians' offices. Experts estimate that their prevalence ranges from less than 2% of hospitals (for fully operational EMRs) to as high as 16% for EMRs in physicians' offices.(2-4) This sluggish implementation means that, although EMRs carry a tidal wave of expectations, to date they have left only small puddles in doctors' offices and hospitals. Supporters of electronic records blame the low adoption rate on physician stinginess, technophobia, and timidity, but the reality is more complex. Clinicians are also reacting to well-documented EMR implementation and usability difficulties, which I will review below.(2,3)

## Potential Challenges with EMRs

Despite their possible benefits and the push for implementation, EHRs are associated with a number of potential problems. This case in particular raises some systemic issues about EMRs *in situ*—independent of any faults with the EMR itself.

First, sending data across computer systems is often a perilous journey, with possible distortions and uncertain arrivals. As in this case, these sorts of errors are hard to track—there is rarely an alert for information not received, or received but inaccurate. Also, what about the other patient whose dermatopathology findings never arrived?

Second, EMR installation (like most health care information technology [HIT] installations) usually takes many months to a few years. The EMRs must work with the hospital's several other computer systems, which are often implemented and updated on overlapping schedules. As implementations and updates proceed in parallel, software and work processes change in ways that create barriers to smooth and fail-safe communication. Systems that harmonized on Monday might be incommunicado on Wednesday. And, in a complex environment with multiple systems, re-programming or software changes to fix one issue can easily create more problems.

Third, unintended consequences are the rule in EMR implementation. There is no map of the myriad hospital and office processes that affect, and are affected by, EMR use, data input, and data output. Despite intensive planning, unforeseen problems inevitably arise, e.g., a requirement to provide a diagnostic code to order a lab test may have tragic consequences when the "made-up" (but erroneous) diagnosis becomes embedded as part of the patient's medical history.

All HIT implementations require never-ending vigilance and on-the-floor observation to "get it right." Clinicians are also inventive creators of workarounds when faced with system barriers—their need to help patients supersedes HIT protocols.(5) Hence clinicians, for example, will reach into one patient's medication supply to grab a prepared IV bag for another patient in urgent need. While the clinicians undoubtedly feel that they are supporting their patient's needs, this type of "swap" can play havoc with the EMRs, which are often integrated with the hospital's CPOE, pharmacy dispensing system, and medication barcoding system.(4)

Next, most EMRs undergo massive customization during implementation (3,4,6), involving how information is displayed, order sets, warnings on drug–drug interactions and dosages, permission requirements, and linkages to other hospital IT systems. With millions of lines of computer code, error possibilities are staggering. Linkages with other new systems escalate error odds further.

Another problem with EMR implementations involves the absence of standard definitions and processes. For example, there may be more than 20 ways of writing the same patient's name in any one hospital ( Table). In addition, long names may be truncated by EMRs, patient record numbers or room numbers may be attached to names as suffixes, and innumerable misspellings and transliterations are commonplace in EMRs and can set up medical mistakes. The variety of ID numbers for each patient is also disconcerting. Name and ID matching errors are common. In my own studies of a CPOE system (7), almost all residents reported having accidently entered orders in the wrong patient's electronic chart at one time. While these

house officers uniformly reported catching their errors before closing the electronic chart, it goes without saying that they probably didn't catch the errors they did not notice. Barcoding offers some protection yet generates scores of other error-risks.(5)

Also, data displayed in electronic records always appear neat and tidy (as I'm sure the display of the neck biopsy results appeared in this case). These entries offer no clues that might reveal a patient identification error. For example, data displayed in the chart are usually without additional identifying information such as room number, referring physician, or other illnesses—items that might trigger a viewer's questions. (Note: remember that paper-based records came with many problems, too.)

Finally, many health care organizations keep their electronic systems in silos. In this case, the inability of the dermatopathologists to check the patient's record is remarkable. If the hospital had installed the full EMR in that lab, dermatopathologists could review cases and see, for example, that this patient had no neck lesions. One could imagine that the cost of making the core EMR system available to different departments and labs would be far outweighed by the benefits to patients and clinicians.

Some might argue that improved interoperability—creating seamless connections among computer systems—would help prevent problems like the one in this case. But interoperability could also create a river of information that would flood clinicians with massive amounts of data, not just what is needed to improve patient care. More data do not automatically equal better care. In this case, the (wrong) datum seamlessly moved from the dermatopathology lab's computer system to the EMR. It was then correctly placed into the appropriate spot in the EMR where it was easily read by the patient's physicians. It has been said that computers can be extraordinarily efficient error propagators—incorrect data flow as easily as valid data.

Moreover, having more computer systems feeding information to EMRs also increases the possibility of misplaced information. Thus, the efforts of industry-led certification groups to enhance information exchange across HIT platforms may unintentionally produce EMRs populated with information that is neither well integrated nor well displayed. To date, most vendors have focused on integrating data within their own suites of programs, not across platforms. Patient information that is displayed to physicians in unfamiliar formats may be of limited value. Inadequate integration of patient information from several systems may produce a patchwork of confusion rather than a gain in clinical insights.

This case demonstrates the phenomenon of an error that is associated with an EMR, but one in which the EMR software itself did *not* make an error. Such EMR-related errors are common and must be addressed if we are to fully benefit from this valuable technology. Common EMR-related errors include: (i) the often labyrinthine EMR user interfaces, where essential information might be on screens seven clicks away, or where finding it may require endless scrolling and searching; (ii) graphic displays (user interfaces) that obscure or separate essential data; (iii) the challenges of accurately entering clinical data while directly caring for (and talking with) patients; (iv) disruptive decision-support warnings or unwanted suggestions (of which about 85% are ignored), leading to "alert fatigue" (8); and (v) internal software mistakes, such as incorrectly using body weight in pounds to compute suggested dosages rather than the kilograms the software expects.

Although the present case was not a true EMR error, we have found many examples of errors like those listed above in our studies of EMRs.

## Solutions

Although some question the wisdom of the proposed vendor/government-supported forced march toward widespread EMR implementation, experts in the field are unequivocal in supporting EMRs as patient safety and efficiency tools. Our recommendations are:

*More EMRs and better integrated EMRs.* Integration of the dermatopathology lab into the hospital's EMR system would have reduced the probability of this error because the physician entering the lab results would have been able to see the patient's record.

*Better EMRs*. The good news is that many of the EMR graphic display sins and other difficulties are largely addressable. If vendors were more aggressive in repairing clunky interfaces and functions, they would not have to pressure clinicians to use EMRs via governmental rules and subsidies. Instead of blaming clinicians' character flaws for the tepid adoption of EMRs, vendors should look to their own failures in quality, design, and responsiveness.

*Smarter EMR implementations*. Implementations are more wrenching than they need to be. Each implementation is treated *de novo*; there is little learning or sharing among medical facilities. This isolation must stop. Hospitals and clinicians should own the process of implementation and should benefit from each other's experiences. Agencies such as AHRQ can help by facilitating research and information exchange.

*Attention to EMR-generated errors*. Most research on EMRs has focused on documenting the advantages over traditional paper systems. Let's declare victory in that battle, and now examine the neglected reality of EMR-generated errors. As these errors are revealed, we must seek solutions for them.

*Less unnecessary customization*. Customization is often a marketing ploy and is always a double-edged sword. EMRs that are well designed from the get-go would eliminate many of these struggles. Some customization may be necessary, as in the need for weight-based algorithms for medications in children's hospitals. But each children's hospital need not build these complex algorithms in isolation. Even systems that require customization will ultimately benefit from standard user interfaces and core processes.

*Unique patient identification*. No technical fix can eliminate the need for careful name and patient identification. Because the United States prohibits a unique medical ID, as EMRs and interoperability grow, identity errors will increase, causing more avoidable errors and death. There is no facile solution for this dilemma. Privacy advocates offer good arguments about the dangers of a unique medical ID. On the other hand, ID errors kill, injure, and cost billions of dollars. We must search for a reasonable solution.

That the medical team found the error is perhaps the most encouraging part of this case. It illustrates the caring and professionalism of dedicated clinicians—despite, or in addition to, the many benefits and promises of EMRs.

## Take-Home Points

- Medical informaticists have focused on demonstrating EMRs' many advantages over paper patient charts, but have generally ignored EMR-related errors.
- Interoperability will offer much information from many sources. We must ensure, however, that EMR information is integrated and displayed in ways that work for clinicians.
- With the efforts toward interoperability, EMR information mix-ups may increase unless we find a workable way to achieve unambiguous patient identification.
- The apparent neatness of information in EMRs may obscure data of uncertain accuracy. Similarly, poorly displayed data or data unnecessarily spread across many screens can generate errors.
- EMRs are undoubtedly better than paper records. The funding to encourage EMR use, however, should not force us to prematurely implement inadequate EMRs.

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## References

1. Werner E. Questions surround health IT money. Washington Post. March 23, 2009. [Available at]

2. Jha AK, DesRoches CM, Campbell EG, et al. Use of electronic health records in U.S. hospitals. N Engl J Med. 2009;360. [go to PubMed]

3. Hoffman S, Podgurski A. Finding a cure: the case for regulation and oversight of electronic health record systems. Harv J Technol. 2008;22:104-164. [Available at]

4. Harrison MI, Koppel R, Bar-Lev S. Unintended consequences of information technologies in health care—an interactive sociotechnical analysis. J Am Med Inform Assoc. 2007;14:542-549. [go to PubMed]

5. Koppel R, Wetterneck T, Telles JL, Karsh B-T. Workarounds to barcode medication administration systems: their occurrences, causes, and threats to patient safety. J Am Med Inform Assoc. 2008;15:408-423. [go to PubMed]

6. Dixon BE, Zafar A. Inpatient Computerized Provider Order Entry: Findings from the AHRQ Health IT Portfolio. Rockville, MD: Agency for Healthcare Research and Quality; 2009. AHRQ Publication No. 09-0031-EF.

7. Koppel R, Metlay JP, Cohen A, et al. Role of computerized physician order entry systems in facilitating medication errors. JAMA. 2005;293:1197-1203. [go to PubMed]

8. Sinsky CA. E-nirvana: are we there yet? Fam Pract Manag. 2008;15:6-8. [Available at]

## Table

Table. Example of how a hospital might write one patient's name 22 different ways.

- J N Tobias
- J Noel Tobias
- J Tobias
- JNTobias
- Jonah N Tobias
- Jonah Noel Tobias
- Jonah Tobias
- JonahNTobias
- JTobias
- Tobias J
- Tobias J N
- Tobias, J
- Tobias, J N
- Tobias, J Noel
- Tobias, Jonah
- Tobias, Jonah N

- Tobias, Jonah Noel
- TobiasJ
- TobiasJN
- Tobias J N
- TobiasJonahN
- TobiasJonahNoel

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