Chapter 16
Electronic Medical Systems

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Introduction

Electronic medical records (EMRs) offer the potential to improve quality of care, provide reminders and tracking for preventive health, and facilitate health information exchange. However, EMRs require extensive training, may negatively impact the patient-physician interaction, and create new safety concerns.

In 2016, it was reported that 96% of hospitals and 74% of office-based providers have EMRs [1, 2]. This is a dramatic change since 2009 when only 12% of hospitals and 48% of office-based physicians reported even basic EMR use. This rapid adoption has challenged physician practice as well as residency training to keep pace.

The impetus for this change was the HITECH Act which requires EMR adoption and "meaningful use." The Office of the National Coordinator for Health Information Technology (ONC) and the Centers for Medicare and Medicaid Services (CMS) were tasked with defining "meaningful use" objectives and measures: stage 1, implemented in 2011, focused on data capture and sharing, stage 2 in 2014 on promoting exchange of health information, and stage 3 in 2016 on improving outcomes. The Medicare Access and CHIP Reauthorization Act of 2015 (MACRA) has further incentives for advanced EMR functionality and use beginning in 2017.

Resident continuity clinics and academic medical centers have been early adopters of EMRs, and at this point, the vast majority of resident clinics use an EMR: a 2016 Society of General Internal Medicine (SGIM) survey of continuity clinic

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directors found that 97.4% of resident continuity clinics had an EMR in place. Of those, 54% had a single EMR for both inpatient and outpatient visits, 29.7% had a different but linked EMR, and 10.8% had completely separate inpatient and outpatient EMRs.

Learning Objectives

1. Understand the training needs of residents in effective EMR usage, both in and out of the exam room.
2. Recognize the use of EMRs in facilitating team-based care and patient communication and understand best practices in these areas.
3. Demonstrate the ability of EMRs to track performance measures and enhance population health management.
4. Identify key pitfalls of current EMR systems and ways to improve safe use.

Outline

- **Training Residents or New Users in EMR**

    - Transition from Medical Student EMR Use
    - EMR Training in Orientation and beyond

- **Optimizing Clinic Notes**

    - Electronic SOAP Notes
    - New Note Formats
    - Best Practices in Electronic Documentation

- **Evaluating Resident Use of EMR**

    - EMR Skill Development
    - RIME Scheme for Evaluation of Documentation

- **EMR and Patient Interactions**

    - EMR Use During Patient Encounters
    - Best Practices for Patient-Physician-Computer Interaction
    - Pre-writing notes

- **Using EMR for Patient Communication**

    - Patient Messaging
    - Professionalism in Electronic Patient Communication
    - Handling Inappropriate Communication

- **Using EMR for Team Based Medical Care**
  - Intraprofessional Communication
  - Team Based Management of Results
    - ◦ Using Pools

- **Using Dashboards for Population Health and Performance Measures**
  - Delivery of Performance Measures
  - Advantages of Dashboards
    - ◦ Care Delivery
    - ◦ Time Management
    - ◦ Batch Actions
  - Dashboard Features
  - Training and QI Use

- **Pitfalls and Safety Concerns with EMR Use**
  - EMR Pitfalls
    - ◦ Inaccurate Documentation
    - ◦ Alerts and Ordering Errors
    - ◦ Medication Reconciliation Errors
    - ◦ Resident Clinic Work Flows
  - Combatting Safety Concerns

Training Residents or New Users in EMR

Training residents in ambulatory EMR use can be challenging as inpatient and outpatient EMR work flows are often very different. PGY-1 residents will have a variable level of comfort with the EMR depending on whether they used a similar EMR as a medical student. For some residents, they will be learning a completely new system. In addition, new faculty hires may need to be trained in a new EMR system.

PGY-1 residents trained in medical schools with EMRs may lack experience in directly placing orders. Prior to the advent of electronic orders, it was common practice for medical students to write out orders and then have a resident or attending cosign them, preparing students for clinical practice. This is still possible in many EMR systems, but it is often easier for the residents to place the orders themselves in the EMR, rather than waiting for the medical student to place them. This lack of experience can make the first few months of clinic more challenging.

PGY-1 residents are typically introduced to the EMR through some type of training during intern orientation. Training often includes computer-based practice sessions in a training or "playground" context. Residents may also find handouts with "tip sheets" useful. Most of the training usually happens on the job during the first several clinic sessions. Shadowing senior residents or attendings can help interns learn how to efficiently use the EMR. We have found it helpful to also have an EMR refresher session a few months into the intern year. Some programs have incorporated a clinic training "boot camp" into their intern orientation time [3].

Optimizing Clinic Notes

The twenty-first-century clinic note simultaneously serves a multitude of purposes: to document observations, assessments, and plans; to communicate with other members of the healthcare team; and to justify billing to third-party payers. Since the late 1960s, the subjective, objective, assessment, and plan (SOAP) note has been the standard note format for clinical encounters. With the widespread migration to EMRs, the SOAP note has simply been converted to electronic format. Yet even the basic order of the SOAP note has been criticized with physician surveys and eye-tracking programs showing that the assessment and plan portions are typically read first and reviewed the longest [4–8]. This fundamental flaw, in addition to others relating to documentation efficiency, raises questions as to whether the SOAP format is still able to meet the demands of the modern clinic note.

Little research exists on how to teach residents to be effective note writers or what even defines a high-quality note. Instruments have been published that aim to measure note quality, but these are often grading rubrics applied to each historical note element rather than appraising the quality of the note as a whole [9, 10]. Such instruments do not address redundancy, extraneous information, or the fact that certain sections of the note, such as the review of systems (ROS), are often considered unhelpful and add to clutter. Likewise, key components of documentation such as care coordination, which do not traditionally have a dedicated section, may be overlooked.

Structured formatting of documents can impact the ability of information to be communicated to physicians and patients. In addition to standardizing documentation, new types of note formats are being developed and are in the process of being evaluated. In 2012, the University of Colorado introduced reverse note templates (APSO) to 13 outpatient clinics [11]. Overall, a majority of authors and readers of APSO notes were satisfied with the new format. Others advocate for problem-oriented charting with progress notes for each chronic condition as a means to facilitate longitudinal management.

Until further research can guide note-writing practices, standardization should be encouraged to allow for information to be more easily discovered irrespective of the note author and to ensure documentation is compliant with billing needs. Residents should be encouraged to be selective in their inclusion of data and to avoid "note bloat." Likewise, they should avoid or be assiduous when using copy/forward [12]. Since patients may be seen by different resident physicians as well as by nurse practitioners and physician assistants, including documentation about what should be done at subsequent visits may facilitate improved continuity of care.

Evaluating Resident Use of EMR

There have been few studies of how to effectively evaluate how well residents are using the EMR. Nuovo et al. conducted an assessment of 19 EMR skills on all 68 of their PGY-1 residents at the University of California Davis Medical Center [13]. They found that 3–4 months after completing EMR training, most of the interns demonstrated competency in the EMR skills tested. They also found that for at least one of the measures, residents' performance improved over time, showing an improvement in medication reconciliation from 57% in July 2012 to 80% in November 2012.

Stephens et al. propose using the RIME (reporter-interpreter-manager-educator) scheme to assess and evaluate learners' use of EMR. The EMR-specific skills are also tied into ACGME core competencies (see Table 1). This strategy can help clinic attendings assess their residents' competency in EMR use over time [14].

Table 1 The RIME/EMR scheme in the context of the Accreditation Council for Graduate Medical Education core competencies in medical education

Level	Clinical skills[a]	EMR-specific skills[a]
Reporter	• Takes ownership of the patient's findings[1,5]	*Clinical data entry*
	• Differentiates normal and abnormal[2]	• Records the complete medical history and exam[1,2]
	• Accurataely obtains and reports basic information from history and physical exam[1,5]	• Reliably completes S/O sections of SOAP note[1,4]
	• Clearly communicates clinical facts about patients[1,4]	• Records own findings rather than "cut and paste"[5]
	• Answers the "what" questions about patient care[2]	• Reviews medical history in EMR for relevant conditions[2,3,6]
	• Uses appropriate clinical language (semantic competence)[4]	• Respects confidentiality and privacy[5]

Table 1 (continued)

Level	Clinical skills[a]	EMR-specific skills[a]
Interpreter	• Identifies and prioritizes new clinical problems[1,3]	*Data assessment*
	• Constructs a differential diagnosis related to each clinical problem[2,3]	• Reliably completes A section of SOAP note[2,4]
	• Interprets data, including laboratory and radiology[2,3]	• Interprets new ancillary data, including laboratory, radiology, and consultative remarks, and incorporates into note[1,2,6]
	• Takes ownership for addressing the "why" questions to explain changes in patient status[1,4,5]	• Independently constructs patient problem list[1,2,3]
		• Discusses clinical assessment and diagnostic possibilities[4,6]
Manager	• Activated learner, suggests potential management options[3,4]	*Data assimilation*
	• Plans include several appropriate diagnostic and treatment options[1,3]	• Constructs P section of SOAP notes independently[2,3]
	• Takes ownership of answering "How do we solve this?" questions about patient care[3]	• Uses available clinical information to request appropriate ancillary requests and consultations[3,4,6]
	• Treatment plan considers relative value of different options[1,6]	• Articulates a logical and semantically competent therapeutic plan[1,4]
	• Individualizes plan to patient needs and circumstances[1,3,4]	• Inserts images and text into EMR to complement plan[4,6]
		• Decides on appropriate follow-up interval based on documented care plan[1,2,6]
Educator	• Takes ownership for educating self, colleagues, and patients[3,4]	*Clinical decision support*
	• Searches literature to cite best available evidence related to patient care[1,2,3,6]	• Uses embedded clinical support tools to access current evidence related to patient care[1,2,6]
		• Uses information to provide patient-centered education specific to individual patient needs[1,3,4]
		• Modifies care plan in accordance with best available evidence[2,3,6]

Table from: Stephens, Mark; Gimbel, Ronald; Pangaro, Louis. Academic Medicine. 86(1):11–14, January 2011. DOI: https://doi.org/10.1097/ACM.0b013e3181ff7271

[a]Competencies are indicated for each skill by the following numbers: 1 = patient care; 2 = medical knowledge; 3 = practice-based learning; 4 = communication skills; 5 = professionalism; 6 = system-based practice

EMR and Patient Interactions

Studies of the effect of the EMR on physician interaction with patients have yielded mixed results. Typing and entering data into the EMR can affect the physician's ability to maintain eye contact with the patient. Residents and physicians may also rely more on the data from the computer rather than eliciting a full history from the patient themselves. There has been little research on how to effectively train residents to use the EMR effectively during patient visits.

Residents should be taught some basics on using the EMR while maintaining patient rapport such as:

- Spend the first few minutes "computer-free."
- Have the patient sit where the resident can both look at the patient and the computer screen.
- Explain to the patient what you are doing.
- Turn the computer screen toward the patient to review labs or imaging studies with the patient.
- Turning the computer screen toward the patient can also be helpful during medication reconciliation.
- Use the EMR to note conversational social history such as what kind of work they do, hobbies, names of spouses or children, etc. These can be helpful to refer back to at the next visit and help establish ongoing rapport.

It's still unclear whether the overall impact of the EMR on the patient relationship is positive or negative. One study by Taft et al. found that in a patient simulation exercise, resident communication was better using an EMR on a laptop than using a paper chart [15].

Clinic attendings have a responsibility to help the residents remember to focus on the patient rather than focusing too much time and energy on the chart or the "iPatient" as has been described by Abraham Verghese [16]. Often residents feel overwhelmed by the amount of data in the chart and spend too long reviewing this, while the patient is left sitting alone in the exam room. One remedy for this and an advantage of the EMR is to have residents review patient information prior to clinic and/or "pre-write" notes.

Using EMR for Patient Communication

Many EMRs allow direct patient messaging. This can be especially helpful for communication with resident clinic PCPs as residents can respond to these messages when they are not physically in continuity clinic. In our clinic, messages are first

triaged by medical assistants, and those messages with "symptom complaints" are routed directly to triage nurses to avoid any delay in care.

Residents should be reminded that as all patient communication is stored in the EMR, a professional language and a respectful tone are important. Many clinics are moving to an "open notes" system where patients can directly access their clinic notes. This allows the patient to play a more active role in their care. As notes become another means of patient communication, residents will need to be trained to write notes that convey all the needed information in a way the patient is likely to understand.

Residents may also need training in how to handle patient communication that may be deemed inappropriate. We encourage any residents who are receiving messages from patients that are antagonistic or otherwise inappropriate to promptly alert their clinic attending.

Using EMR for Team-Based Medical Care

The EMR can be a useful tool for team-based medical care. Residents can communicate directly with members of their care team such as medical assistants, RNs, pharmacists, etc. Residents can also use messaging systems within the EMR to communicate with consulting specialists which can be quite educational. Residents and staff should receive training on how to use direct patient messaging appropriately, keeping in mind that messages become part of the patient's medical record.

Each clinic will need to have a system for residents, faculty, and/or staff to indicate that they have taken care of a particular lab result or imaging result. In EPIC, the result note function can be used to indicate what action has been taken on a particular result. This can be particularly helpful for facilitating a team approach to patient care.

The EMR can also allow for cross coverage between residents when they are not available. Many programs organize residents into "firms," a small group of residents that cover each other's patients. Residents can then check the inboxes of the other residents in their firm as needed. Labs and messages can also be sent into "pools" allowing multiple user access.

Using Dashboards for Population Health/Performance Measure

The ACGME requires "evaluation of performance data for each resident's continuity panel of patients relating to both chronic disease management and preventive healthcare" [17]. EMRs greatly facilitate the ability to compile data on resident

performance measures. This data may be obtained from individual reports or may be compiled into a comprehensive "dashboard."

Both reporting performance measures and the use of dashboards have been shown to improve adherence to guidelines and delivery of care such as appropriate prescribing of corticosteroid inhalers in asthma, adherence to COPD indicators, and communication of CT results to patients [18]. Their use has been associated with improved diabetes process measures as well as hard outcomes, such as reduction in hemoglobin A1c levels [19].

In terms of work flow, dashboards have been shown to reduce the time needed to find key diabetes care elements within the medical record, increase the accuracy of the data identified, and reduce physician propensity to retest when the data is not easily found [20].

While dashboards can be displayed within the EMR or separately, providers have been shown to prefer integration and the ability to drill down into individual patient records. In addition, batch actions can allow providers to send letters or enter orders for a group of patients at once.

Resident dashboards can be configured to provide components displaying:

- Panel size and demographics
- Population health metrics
- Patient and provider continuity data
- Patient appointments and referral follow-up
- Emergency department visits and admissions
- Resident charting such as visit closure, medication reconciliation, and lab review

Resident and preceptors training in dashboard use can demonstrate display of performance metrics, benchmarking criteria, drill down capability, and actionable features. EMR reports and dashboard displays can also provide impetus for quality improvement projects and enable residents to obtain meaningful population data.

Pitfalls/Safety Concerns with EMR

While EMRs reduce certain types of errors such as illegible or incomplete prescriptions, they also introduce new types of errors in documentation, order processes, and lab follow-up of which users may not be aware. Often these errors are not apparent.

Because most EMRs allow for templated notes which automatically populate data from within the electronic record, incorrect data entry from multiple sources can impact documentation. Copying and pasting can lead to inaccurate or outdated information being perpetuated in the medical record. Physical exam macros that are pre-populated make it easy to accidentally include parts of the physical exam that were never done or falsely document normal findings. Likewise, the use of standardized phrases can result in oversimplification of complex medical information.

Errors in ordering can result from cognitive overload from overly busy screens, overreliance on EMR-prompted dosages, and faulty decision support tools [21, 22]. There is concern that reliance on electronic alerts or reminders may cause learners to be less likely to look up potential drug interactions prior to prescribing. Likewise, too many alerts and pop-ups may lead to a sense of alert fatigue that then leads people to ignore the alert.

Medication reconciliation is especially susceptible to errors. In an EMR, many providers access the same medication list, but as a result, there may be no ownership for updating the med list. Poor reconciliation of medications over time or with transitions of care leads to inaccurate medication lists. In addition, currently in 2016, there is electronic transmission of prescriptions to pharmacies but no similar process of transmitting a message to the pharmacy when discontinuing a medication. Fixing this failure in electronic "deprescribing" medications is one of the mandates within MACRA and should be addressed by updates to pharmacy software and protocols in 2017–2018.

Finally, in resident clinic, there are unique concerns regarding creation of safe work flows for times when residents are on other duties or away. This includes having mechanisms in place for routing of prescription refills, patient messages, and laboratory and radiology results. Often resident clinics rely on attaching in baskets or creating "pools" to ensure results are appropriately reviewed. However, these solutions generate concerns about responsibility, patient safety, and education when the ordering provider is not the person who checks the labs.

Safety in resident clinics involves, first, generating a robust system for reporting errors and safety concerns. Comprehensive Unit-based Safety Program (CUSP) teams can review errors and adopt QI projects aimed at improving identified safety issues [23]. We recommend close collaboration between residents, staff, administration, and IT with attention to:

- Standardization of note templates and copy forward practices
- Development of preference lists and order sets
- Protocolling medication reconciliation and medication discontinuation procedures
- Creating EMR work flows for refills, messages, and labs

Conclusion

Training of residents in effective use of EMRs in patient care requires attention to optimizing documentation, maintaining patient-physician interactions, ensuring safe management and communication of results, and delivering performance measures to enhance population health. Best practices around these areas and means of evaluation are still evolving, and residency programs have the opportunity to be leaders in incorporation and improvement of health IT.

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