Chapter 4 - The Role of Information Technology in Healthcare
Healthcare Information Technology Exam Guide for CompTIA Healthcare IT Technician and HIT Pro Certifications
by Kathleen A. McCormick and Brian Gugerty
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Chapter 4: The Role of Information Technology in Healthcare

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In this chapter, you will learn how to

- Describe how healthcare information technology (IT) improves the quality, safety, and efficiency of care
- Describe the key components of the electronic health record (EHR)
- Discuss the benefits and current adoption rates of EHRs among physicians and hospitals
- Discuss barriers to EHR adoption for both physicians and hospitals
- Explain how federal programs address many of the barriers to EHR adoption
- Describe the benefits of health information exchange and current levels of adoption
- Discuss the barriers to health information exchange
- Explain how federal programs are promoting and supporting health information exchange
- Describe the different types of electronic tools used by consumers and patients to help them navigate their health and healthcare and their benefits
- Describe the barriers to adoption of consumer-facing electronic tools among both consumers and providers
- Explore how current drivers in the healthcare system are likely to impact the adoption and evolution of EHRs, health information exchange, and consumer-facing applications in the future

Concerns about rising costs and uneven quality in the U.S. healthcare system have spurred significant interest in and adoption of healthcare IT as a foundational component of efforts designed to improve health, improve healthcare, and reduce the cost of care. A considerable amount of research supports the positive impact that healthcare IT has on healthcare-related outcomes.

A recent comprehensive review of the literature indicates that 92 percent of the more than 150 articles recently published on healthcare IT reached conclusions that were positive overall, citing positive results in areas related to efficiency of care, effectiveness of care, provider satisfaction, patient safety, and patient satisfaction. [1]

Healthcare IT enables clinicians, nurses, care managers, and other providers who care for patients—as well as patients themselves—to have access to information about both the patient and what constitutes optimal care in order to support clinical decision making at the point of care and in between visits. A majority of the investment in healthcare IT in the United States to date has been made in applications that support the delivery of care by clinicians, hospitals, and other healthcare providers. These applications are ordinarily referred to as *electronic health records*.

Healthcare IT also enables the exchange of data across the settings in which patients receive care. Because of the fragmented nature of the U.S. healthcare system, information about the patient resides within the range of settings in which healthcare and services are delivered, including physician practices, hospitals,

laboratories, pharmacies, health plans, and even patients themselves. Mobilizing this information through health information exchange enables those who care for patients—as well as patients themselves—to have access to important information about the patient, regardless of where it is located.

Finally, healthcare IT enables consumers and patients to more effectively manage their health and healthcare by offering online educational resources, tracking and self-monitoring tools, easy access to their health records across the range of settings where they receive care, and even secure modes of communication to connect with their clinicians between visits.

This chapter will explore the role of IT in each of these three areas: bringing information to clinicians and other care providers to support the delivery of care through the use of EHRs; through health information exchange, mobilizing information that resides across the many settings in which individuals receive care and services; and utilizing online and electronic tools to support consumers as they manage their health and healthcare.

A fourth area in which healthcare IT plays a critical role in improving the quality, safety, and cost-effectiveness of care is that which relates to the analysis of electronic data to support improvements in the health of populations. Healthcare IT enables healthcare organizations to access and analyze electronic health information to monitor performance, identify opportunities for improvement, and take actions to improve outcomes in cost, quality, and patient satisfaction.

The analysis of large electronic data sets also supports other population health goals, including accelerating research on the effectiveness of various treatments on health outcomes, monitoring the safety of medical products such as medical devices and pharmaceuticals, identifying new therapies designed to battle deadly diseases such as cancer, and monitoring and responding to public health threats. A more detailed description of these other uses of IT to improve health and healthcare at the population level are addressed in Chapters 7 and 8.

An Overview of Electronic Health Records and Their Use by Physicians and Hospitals Across the United States

Historically, electronic health records have been the cornerstone of HIT-related efforts focused on improving health and healthcare. Over the last several years, the adoption of EHRs has steadily grown but still remains fairly low. EHRs enable clinicians, hospitals, and other providers to have access to important information about the patient, as well as clinical decision support, both of which assist with the delivery of higher-quality, more cost-effective care. EHRs enable clinical alerts and reminders that help clinicians avoid drug interactions that can cause harm and reduce both gaps and duplications in care.

A review of EHRs used both in physician practices and in hospitals, current adoption rates, key challenges associated with adoption, and federal programs designed to address such challenges, is provided in the following sections.

Physician Use of Electronic Health Records

Physician use of EHRs has grown steadily in the United States over the past several years. Adoption of a "basic" EHR among office-based physicians has nearly tripled in the last five years, from 11.8 percent in 2007 to 33.9 percent in 2011.[2]

A "basic" EHR is defined as one that includes basic features such as the following:

- Patient history and demographics
- Patient problem list
- Physician clinical notes
- Comprehensive lists of medications and allergies
- Computerized orders for prescriptions
- The ability to view laboratory and imaging results electronically

Adoption of "any EMR/EHR system," which is a medical or health record system that is all or partially

electronic, grew from 34.8 percent in 2007 to 57 percent in 2011.

EHR adoption among physicians varies by specialty status, physician age, and practice size. Primary-care physicians are more likely to adopt EHRs than nonprimary-care specialists, older physicians (55 and older) are less likely to adopt EHRs than their younger counterparts, and physicians in small (one to two providers) practices are less likely to adopt than those who deliver care in larger practices.[3]

Commonly cited barriers to EHR adoption among physicians include lack of access to capital to support purchase of systems; uncertainty about the return on investment; lack of capacity to evaluate, select, and install such systems; concerns that the systems will become obsolete; worries about privacy and security protections; and lack of a trained workforce to assist with implementation.[4], [5], [6]

> **Tip** EHR user satisfaction is higher among individuals who have participated in the selection of their EHR system versus those who have not.[7]

Hospital Use of Electronic Health Records

Adoption of EHRs among hospitals has also experienced steady growth, but similar to adoption rates of physicians, adoption rates among hospitals continue to be fairly low. Eighteen percent of hospitals had a "basic" EHR system in place in 2011, up from 11.5 percent the previous year; while the percentage of hospitals that had a "comprehensive" EHR system increased from 3.6 percent in 2010 to 8.7 percent in 2011.[8]

A "basic" system is defined as full implementation of the following technologies in at least one clinical unit of the hospital:

- Computerized systems for patient demographics
- Physician notes
- Nursing assessments
- Patient problem lists
- Laboratory and radiologic reports
- Diagnostic test results
- Order entry for medications[5]

On the other hand, a "comprehensive" EHR system includes all of the functions that a basic system can perform and 14 additional functions. In addition, to meet the comprehensive definition, all functions must be present in all major clinical units in the hospitals.[5]

EHR adoption rates are not the same across all hospitals. Small, nonteaching, and rural hospitals tend to adopt EHRs more slowly than other hospitals.[7] Barriers to adoption among all hospitals are similar to those cited for physicians and are generally more pronounced in smaller or rural systems. They include lack of capital for up-front costs, concerns about the ongoing costs of maintaining and upgrading systems, physician resistance, and lack of a trained workforce to assist with implementation.[8]

> **Tip** Overall EHR user satisfaction is highly correlated with the length of training. At least three to five days of EHR training is necessary to achieve the highest level of overall satisfaction.[9]

[*]David deBronkart contributed to the section "Engaging Consumers Using Electronic Tools."

[1]Buntin, M. B., Burke, M., Hoaglin, M., and Blumenthal, D. (2011). The benefits of health information technology: A review of the recent literature shows predominantly positive results. *Health Affairs, 31(3)*, 464–471.

[2]Hsiao, C., Hing, E, Socey, T. C., and Cai, B. (2011). Electronic health record systems and intent to apply for meaningful use incentives among office-based physician practices: United States, 2011–2011. *NCHS Data*

Brief, 79.

[3]Decker, S. L., Jamoom, E. W., and Sisk, J. E. (2012). Physicians in nonprimary care and small practices and those age 55 and older lag in adopting electronic health record systems. Centers for Disease Control and Prevention's National Center for Health Statistics. *Health Affairs, 31(5)*, 1108–1114.

[4]Boonstra, A., and Broekhuis, M. (2010). Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC Health Services Research, 6(10)*, 231.

[5]Jha, A. K., DesRoches, C. M., Campbell, E. G., Donelan, K., Rao, S. R., Ferris, T. G., et al. (2009). Use of electronic health records in US hospitals . *New England Journal of Medicine, 360(16)*, 1628–1638.

[6]Rao, S. R., DesRoches, C. M., Donelan, K., Campbell, E. G., Miralles, P. D., and Jha, A. K. (2011). Electronic health records in small physician practices: availability, use, and perceived benefits. *Journal of the American Medical Informatics Association, 18*, 271–275.

[7]Edsall, R. L., and Adler, K. G. (2009). The 2009 EHR user satisfaction survey responses from 2,012 family physicians: If you're shopping for an EHR system, you might appreciate advice from a couple thousand colleagues. *Family Practice Management, 16(6)*, 10–16.

[8]DesRoches, C. M., Worzala, C., Joshi, M.S., Kravolec, P. D., and Jha, A. K. (2012). Small, nonteaching, and rural hospitals continue to be slow in adopting electronic health record systems. *Health Affairs, 31(5)*, 1092–1099.

[9]AmericanEHR Partners. (2011). *The correlation of training duration with EHR usability and satisfaction: Implications for meaningful use*. AmericanEHR Partners.

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Federal Programs Designed to Address Barriers to EHR Adoption

The Health Information Technology and Economic and Clinical Health (HITECH) Act of 2009 brought an unprecedented and significant amount of investment to accelerate the adoption of healthcare IT to support improvements in the quality, safety, and efficiency of care. A majority of the $30 billion investment is in the form of incentive payments through the Centers for Medicare and Medicaid Services (CMS) Medicare and Medicaid EHR Incentive Programs.[10] Informally known as *meaningful use*, the programs provide financial incentives to eligible professionals and hospitals when they use certified EHR technology in specific meaningful ways to improve quality, safety, and efficiency.

To qualify for incentive payments, eligible professionals and hospitals must meet certain "core" objectives and also meet a small number of objectives selected from a "menu" set.

Table 4-1 summarizes the core and menu objectives associated with the first stage of the CMS Medicare and Medicaid EHR Incentive Programs.

Table 4-1: Core and Menu Objectives for Stage 1 CMS Medicare and Medicaid EHR Incentive Programs[a],[b]

Objective		Hospitals	Eligible Professionals (EPs)
CORE OBJECTIVES			
1.	Use computerized physician order entry (CPOE) for medication orders.	X	X
2.	Implement drug-drug and drug-allergy interaction checks.	X	X
3.	Maintain an up-to-date problem list of current and active diagnoses.	X	X
4.	Generate and transmit permissible prescriptions electronically (*eprescribing*).		X
5.	Maintain active medication list.	X	X
6.	Maintain active medication allergy list.	X	X
7.	Record demographics: preferred language, gender, race, ethnicity, date of birth, and, for hospitals, date and preliminary cause of death.	X	X
8.	Record and chart changes in vital signs: height, weight, blood pressure, body mass index, growth charts for children.	X	X
9.	Record smoking status for patients 13 years old or older.	X	X
10.	Report clinical quality measures to CMS (or in the case of Medicaid, the states).	X	X
11.	Implement one clinical decision support rule (along with ability to track compliance with that rule).	X	X
12.	Provide patients with an electronic copy of their health information (including diagnostic test results, problem list, medication lists, and medication allergies, as well as discharge summary and procedures for hospitals) upon request.	X	X
13.	Provide patients with an electronic copy of their discharge instructions at time of discharge, upon request.	X	
14.	Provide clinical summaries for patients for each office visit.		X
15.	Capability to exchange key clinical information (for example, problem list, medication list, medication allergies, and diagnostic test results) among providers of care and patientauthorized entities electronically.	X	X
16.	Protect electronic health information created or maintained by the certified EHR technology through the implementation of appropriate technical capabilities.	X	X

MENU OBJECTIVES			
17.	Implement drug formulary checks.	X	X
18.	Record advance directives for patients 65 or older.	X	
19.	Incorporate clinical lab test results into EHR as structured data.	X	X
20.	Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research, or outreach.	X	X
21.	Send patient reminders per patient preference for preventive/follow-up care.		X
22.	Provide patients with timely electronic access to their health information (including lab results, problem list, medication lists, and allergies).		X
23.	Use certified EHR technology to identify patient-specific education resources and provide those resources to the patient if appropriate.	X	X
24.	The EP or hospital or critical access hospital (CAH) that receives a patient from another setting of care or provider of care or believes an encounter is relevant should perform medication reconciliation.	X	X
25.	The EP or hospital or CAH that transitions their patient to another setting of care or provider of care or refers their patient to another provider of care should provide a summary care record for each transition of care or referral.	X	X
26.	Capability to submit electronic data to immunization registries or immunization information systems and actual submission according to applicable law and practice.	X	X
27.	Capability to submit electronic data on reportable (as required by state or local law) lab results to public health agencies and actual submission according to applicable law and practice.	X	
28.	Capability to submit electronic syndromic surveillance data to public health agencies and actual submission according to applicable law and practice.	X	X

[a]Eligible professional meaningful use core measures. (2011). Accessed on September 12, 2012, from http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Meaningful_Use.html.

[b]Eligible hospital and critical access hospital meaningful use core measures. (2011). Accessed on September 12, 2012, from http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Meaningful_Use.html.

A total of $6.2 billion has been made through the CMS Medicare and Medicaid EHR Incentive Programs through June 30, 2012, $2.2 billion of which was paid to approximately 119,000 eligible professionals and the remaining $4 billion of which was paid to about 3,400 hospitals.[11]

The remaining $2 billion in funds authorized by HITECH have been devoted to programs and activities led by the Office of the National Coordinator for Health Information Technology (ONC) to address other key barriers to the adoption and meaningful use of healthcare IT to support higher-quality, safer, more cost-effective care, including the need for implementation assistance, the need for workforce training, and the need for standards and certification processes to provide assurance (Table 4-2).

Table 4-2: Ways in Which HITECH Programs Address Barriers to EHR Adoption, Meaningful Use, and Health Information Exchange

Barrier	HITECH Program	Funding Amount
Lack of financing or a business case for adoption	Medicare and Medicaid EHR Incentive Programs	Up to $27 billion[a]
Lack of capacity to evaluate, select, and implement a system	Regional Extension Center Program	$677 million[b]
Lack of a trained workforce to support implementation	Workforce Development Programs	$118 millions[c]
Concerns about systems becoming obsolete	Standards and Certification Program	$64 million[d]
Concerns about the lack of interoperability across EHR systems		
Concerns about lack of infrastructure for exchange	State Health Information Exchange Cooperative Agreement Program	$547 million[e]
Concerns about privacy and security	Office of the Chief Privacy Officer[f]	n/a

protections		

[a]CMS Medicare and Medicaid EHR incentive programs. (2012). Accessed on August 1, 2012, from www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/index.html.

[b]Regional extension centers. (2012). Accessed on August 1, 2012, from http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__rec_program/1495.

[c]Health ITIT workforce development program. (2012). Accessed on August 1, 2012, from http://healthit.hhs.gov/portal/server.pt?open=512&objID=1432&mode=2.

[d]Blumenthal, D. (2010). Launching HITECH. *New England Journal of Medicine, 362(5)*, 382–385.

[e]State health information exchange cooperative agreement program. (2012). Accessed on August 1, 2012, from http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__state_health_information_exchange_program/1488.

[f]Advancing privacy and security. (2012). Accessed on August 1, 2012, from http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__privacy_and_security/1147.

Tip IT professionals will be expected to understand the purpose and context associated with key elements of the EHR. They will also be expected to understand the requirements of meaningful use.

[10]The Health Information Technology for Economic and Clinical Health (HITECH) Act, Title XIII of Division A and Title IV of Division B of the American Recovery and Reinvestment Act of 2009 (ARRA) (Pub. L. 111-5), enacted on February 17, 2009.

[11]Summary report of CMS medicare and medicaid EHR incentive programs through June 2012. (2012). Accessed on August 1, 2012, from www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Downloads/June2012_MonthlyReport.pdf.

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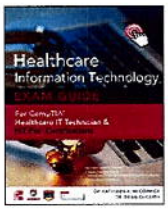

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An Overview of Methods to Electronically Exchange Data Across Settings

The U.S. healthcare system is highly fragmented, with care and services for an individual patient being delivered across a diverse range of settings that can include primary-care clinician practices, specialists' offices, hospitals, laboratories, pharmacies, acute-care clinics, and long-term care settings. An average Medicare beneficiary has more than 15 visits annually and sees 6.4 unique physicians in a year.[12]

In addition, an individual might also capture information at home that is relevant to the health record that is used for care, such as blood pressure readings for patients with hypertension or blood glucose level readings for patients with diabetes. With the use of remote-monitoring devices and mobile technology, increasingly these readings can be transmitted automatically to the patient record and utilized by a care management team to identify trends and issues that require intervention.

High-quality, cost-effective care requires the coordination of care and sharing of information about the patient, across the many settings where care is delivered and tests are performed. Traditionally, this information has been shared using mail, phone, or fax, and in many cases, this information is not shared at all, resulting in the repeat of tests—which can be costly—or in less than optimal care. Primary-care clinicians report that missing clinical information is common, consumes time and other resources, and may adversely affect patients.[13]

The electronic sharing of information—often referred to as *health information exchange*—enables the team of doctors, nurses, and other professionals who care for an individual patient to have access to information about the patient, such as the results of lab or imaging tests performed, prescribed medications, previous diagnoses, allergies, and other information to support higher-quality, safer, effective, and evidence-based care.

While the electronic exchange of information plays a critical role in supporting higher-quality, cost-effective care, the level of health information exchange across the United States today is extremely low. Only 19 percent of hospitals are currently exchanging clinical record information electronically with providers outside of their health system.[14] Very few physicians are electronically exchanging information with other settings outside of their practices. One study indicates that 73 percent of the time, primary-care providers do not receive discharge information from hospitals within two days of their patients' discharge, and when they are sent, they are rarely shared electronically.[15] Data types considered by practicing clinicians to be very important or essential for clinical decision making associated with transitions of care include relevant imaging test results, laboratory test results, and medications.[16]

Physicians perceive benefits in health information exchange. One study indicated that 86 percent of physicians perceive that health information exchange will have a very positive or somewhat positive impact on improving the quality of patient care, and 71 percent perceive a similarly positive impact on reducing healthcare costs.[17] Studies have also shown that health information exchange does reduce costs.[18]

To date, health information exchange has been facilitated by a wide variety of publicly and privately funded health information exchange organizations. One industry study validated 228 health information exchange efforts, 67 of which were primarily funded and governed by government entities and 161 of which were primarily governed and funded by private sponsoring entities.[19] Another recent study identified 179 U.S.-based regional health information organizations, 75 of which were operational.[20] A majority of these efforts have experienced challenges with securing funding and achieving financial sustainability.

Barriers to health information exchange are well documented. The most significant barrier to exchange is the lack of a business case. The predominant method of payment in the U.S. healthcare system today provides reimbursement for the number of visits, tests, or procedures performed, as opposed to rewarding outcomes in quality or cost. As a result, there is little incentive for providers to access information that resides in another

setting, to reduce duplicative tests or procedures, or otherwise to improve the quality or cost of care.[21]

Two current developments are likely to create the business case for health information exchange. Driven by significant pressures to reduce cost and improve quality, new models of care delivery and payment are now rapidly emerging, sponsored by the federal government, states, and private-sector providers and health plans. These models are taking many forms but share common attributes, including increased focus on accountability and coordination of care and payment that is increasingly based on outcomes in cost and quality as opposed to volume.[22] Achievement of the goals of these new models of care will require clinicians and other members of the care team to have access to information about the patient from the various settings in which care and services are delivered, which will necessarily be facilitated by health information exchange.

In addition, while there were limited requirements for health information exchange under the first stage of the CMS Medicare and Medicaid EHR Incentive Programs, the second stage, which is projected to go into effect in 2014, is expected to have more robust requirements for the electronic exchange of information—using standards—to support transitions of care.[23]

Other barriers include the lack of standards adoption and interoperability and lack of access to infrastructure to support exchange.[29],[31] Continued concerns about privacy and security have also been cited as a key barrier.[25]

Concurrent with the release of rules for the CMS Medicare and Medicaid EHR Incentive Programs, ONC also releases federal rules on the standards and certification criteria required for the "certified EHR technology" that must be used for providers to qualify for such incentives. Rules released for stage 1 of the meaningful use program included an initial set of standards to promote the interoperability of EHR systems, including data content standards associated with laboratory test results, medications, problems, and procedures.[24] Additional standards to promote interoperability of systems and health information exchange are expected to be released as part of the final rules associated with stage 2 of meaningful use.[30]

In addition to providing financial incentives, adopting standards for interoperability, and promoting compliance with such standards through a certification program, the federal government has also taken other steps to promote health information exchange. Through the State Health Information Exchange Cooperative Agreement Program, ONC awarded approximately $547 million to 56 states, eligible territories, and qualified state-designated entities to support the development of capabilities for exchange.[18] Several initiatives have also been launched by the Department of Health and Human Services to develop new policies and clarify existing policies associated with privacy and security.[19]

As expectations regarding the use of interoperable systems and the electronic exchange of information across settings continue to grow, IT professionals will be expected to be familiar with standards that promote interoperability across systems and the various methods and infrastructure that will support health information exchange.

[12]The clinical characteristics of Medicare beneficiaries and implications for Medicare reform. (2002). Accessed on September 12, 2012, from www.medicareadvocacy.org/news/archives/chronic-partnerpaper_clinchars.htm.

[13]Smith, P., Araya-Guerra, R., Bublitz, C., Parnes, B., Dickinson, L. M., Van Vorst, R., Westfall, J. M., and Pace. W. D. (2005). Missing clinical information during primary care visits. *JAMA, 293(5)*, 565–571.

[14]American Hospital Association. (2010). *AHA hospital survey*. American Hospital Association.

[15]Commonwealth Fund. (2009). *Commonwealth Fund international health policy survey*. Commonwealth Fund.

[16]Doctors Helping Doctors Transform Health Care and American College of Physicians. (2012). *Survey of clinicians on electronic health information needs: Interim results*. Doctors Helping Doctors Transform Health Care.

[17]Wright, A., Soran, C., Jenter, C. A., Volk, L. A., Bates, D. W., and Simon, S. R. (2010). Physician attitudes toward health information exchange: results of a statewide survey. *Journal of the American Medical*

Informatics Association, 17, 66–70.

[18]Frisse, M., and Holmes, R.L, (2007). Estimated financial savings associated with health information exchange and ambulatory care referral. *Journal of Biomedical Informatics, 40*, S27–S32.

[19]Health information exchanges: Rapid growth in an evolving market. (2011). Accessed on September 12, 2012, from https://www.klasresearch.com/Store/ReportDetail.aspx?ProductID=642.

[20]Adler-Milstein, J., Bates, D. W., and Jha, A. K.. (2011). A survey of health information exchange organizations in the United States: Implications for meaningful use." *Annals of Internal Medicine, 154*, 666–671.

[21]Bipartisan Policy Center. (2012). *Transforming health care: The role of health IT*. Bipartisan Policy Center.

[22]U.S. Department of Health and Human Services. (2012). 45 CFR Parts 412, 413, and 495 Medicare and Medicaid programs, electronic health record incentive program—stage 2, proposed rule. *Federal Register, 77 (45)*.

[23]Gold, M. R., McLaughlin, C. G., Devers, K. J., Berenson, R. A., and Bovbjerg, R. R. (2012). Obtaining providers' "buy-in" and establishing effective means of information exchange will be critical to HITECH's success. *Health Affairs, 31(3)*, 514–526.

[24]U.S. Department of Health and Human Services. (2010). 45 CFR Part 170 Health information technology: Initial set of standards, implementation specifications, and certification criteria for electronic health record technology, interim final rule. *Federal Register, 75(8)*, 2013–2047.

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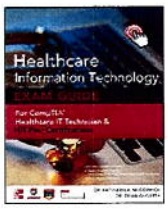

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Engaging Consumers Using Electronic Tools

A wide range of online, electronic, and mobile tools are now available to help consumers manage their health and healthcare. Despite that the Internet plays a significant role in many other aspects of American life, including how people manage their finances, shop for goods and services, and even work, consumer usage of online and electronic applications to support their health and healthcare has yet to become mainstream. As the healthcare system itself becomes more digitized, it is anticipated that the usage of consumer-facing applications will also accelerate.

Consumer-facing tools fall into three primary categories.

- Those supporting individual patient education, self-care, and peer support
- Those supporting both the information and transaction needs associated with care delivery
- Those supporting the actual delivery of care[25]

An overview of electronic tools in each of these areas, along with current adoption rates and barriers to adoption, is explored in more detail in the following sections.

Electronic Tools Supporting Patient Education and Self-Care

The number of consumers in the United States who have used online or electronic tools to support their informational needs in healthcare is high. According to a recent survey, 80 percent of Internet users have looked online for information about any of 15 health topics such as a specific disease or treatment.[26] In 2011, 17 percent of mobile users were using their devices to look up health and medical information.[34]

Increasingly, consumers are using online and electronic tools for self-monitoring and tracking. For example, 20 percent of adults have tracked their weight, diet, exercise routine, or some other health indicators or symptoms online.[34] Forty-two percent of consumers would be interested in using a web site, program, or application to track information about their chronic illness.[27]

As the availability of and interest in social media and other applications that enable online dialogue has increased considerably, so has the use of such tools for health and healthcare. Online communities among patients and caregivers who share similar illnesses or experiences have increased in popularity. One study indicates that 4 percent of adults have posted comments, questions, or information about health or medical issues.[34] One example of a peer support and information-sharing community is Patients Like Me, an online community of more than 157,000 patients with Amyotrophic Lateral Sclerosis (ALS), Multiple Sclerosis (MS), and several other conditions, who share not only their experiences and advice with one another but also information about their health status, including reactions to various therapies. This information is helpful not only to their peers; it can also augment traditional sources of input to the effectiveness and safety of treatments and other interventions.

Electronic Tools Supporting Patient Information and Transaction Needs Associated with Care Delivery

Personal health records (PHRs) enable consumers to both input and aggregate information about themselves, including information derived from a variety of sources, including health plans and the various clinicians,

hospitals, and other providers from which they receive care. PHRs have been in existence for some time, but uptake has not been significant, with current estimates ranging anywhere from 7 percent to 11 percent.[35], [28], [29]

> **Tip** Many believe that the slow uptake of PHRs is related to the limited ability to access and download health information that resides within the EHR of the physician or hospital from which they have received care. As a result, PHRs are for the most part "empty vessels" and therefore not very useful; they must be populated manually, which is tedious and requires sustained effort. Other barriers to PHR adoption include lack of awareness of the availability of such tools, concerns about privacy and security, and limited access to such tools, which can take the form of limited access to the Internet, limited computer literacy or computer skills, or unmet technical or information support needs.[33], [35], [30]

Physician practices, hospitals, and other providers are beginning to enable patients to view—and in some cases—download information about their care from the EHR, including lab test results, images, medications prescribed, care summaries, and follow-up needed, as well as appointments. Both the current availability and the adoption of these services by providers are limited, despite increasing demand from consumers. While 57 percent of PHR users believe that reviewing test results online would be useful, only 6 percent of consumers have actually done so.[35] This low level of adoption is likely because of the lack of adoption of these services among providers.

The significant increase in the use of mobile technology generally is expected to further increase demand for health information from consumers. Fifty-two percent of consumers say that they would use a smartphone, tablet, or other handheld device to monitor their health if they were able to access their medical records and download information about their medical condition and treatments.[36]

Physicians and hospitals are also beginning to enable patients to conduct certain transactions online, including scheduling appointments and renewing prescriptions, but again, uptake among providers has been slow. While 48 percent of PHR users believe that scheduling a doctor visit online would be useful, hardly any consumers are able to do so today.[35] Similarly, while 52 percent of PHR users believe that renewing prescriptions online would be useful, only 15 percent of consumers have actually done so.[35]

Why aren't physician practices and hospitals offering consumer-facing applications if their patients see value in these tools? One of the most obvious reasons is that most physicians and hospitals have not yet adopted EHRs, which are a precursor to offering consumer-facing applications. Physicians in particular are concerned about the "business case" for such offerings, with 63 percent of physicians citing the lack of reimbursement for time spent installing and using such tools as a key barrier.[31] A majority of physicians also has concerns about being held liable for knowing all of the information contained in the PHR, as well as the level of privacy and security protections associated with these applications.[39]

The CMS Medicare and Medicaid EHR Incentive Programs currently require hospitals and clinicians to provide patients with an electronic copy of their health information.[11], [12] It is anticipated that future requirements will also likely include a patient's ability to view and download their information from the EHR.[30] Eligible professionals will also likely be required to send patients reminders for preventive and follow-up care.[30]

Use of Consumer-Facing Electronic Tools to Support Care Delivery

> **Tip** Finally, clinicians and other healthcare providers are increasingly using online, electronic, and even mobile technology tools to support the actual delivery of care. This is taking many forms.

For example, the use of remote monitoring and telehealth to monitor and communicate with patients while in their homes is increasingly taking hold. Augmenting traditional office-based care with ongoing monitoring of patients through the use of medical devices that can check their conditions and automatically send information to the clinician or care management team—particularly for patients with chronic disease—can help identify flags or issues before they become serious and more costly to treat.

Remote monitoring has yet to take off in the United States, even though consumers and clinicians alike see value in their use. While 61 percent of consumers express interest in using a medical device that would enable them to check their conditions and send information to their doctors electronically through a computer or a cell phone,[36] only 6 percent of consumers have actually used a medical device that connects to a computer.[35] One of the primary barriers to the adoption of remote monitoring is again the predominant reimbursement

model in healthcare today that rewards face-to-face visits and procedures, as opposed to virtual encounters and better outcomes.

With e-mail being one of the standard modes of communication for Internet users, *secure messaging* (e-mail between clinicians and patients using secure methods) is becoming more popular among patients, with positive results. Fifty percent of PHR users believe that e-mailing providers would be useful.[35] Research indicates that secure messaging between patients and their providers improves quality of care and outcomes.[38], [32] Some clinicians worry about the volume of e-mails that would result from offering secure messaging services—an outcome that many organizations that offer such services today say is unfounded.[29]

One variation of secure messaging is the use of "reminders" for patients. Clinicians or other members of the care team can either securely e-mail or send text messages to remind the patient to come in for either a preventive measure or follow-up test that is needed, or they can remind the patient to refill a prescription. Forty-four percent of consumers believe that getting reminders for tests would be useful.[35]

While consumers perceive value in their clinicians using electronic methods of communication and research indicates that positive outcomes in quality and cost of care can result, there is very little uptake of these consumer-facing applications among clinicians today.

> **Tip** Many physicians are concerned about the workflow (and therefore cost and resource) impact of the asynchronous and unexpected arrival of outside information from patients.[33] There are also concerns about privacy and security protections related to such services.[39] Finally, for the most part, the current methods of reimbursement and payment in the U.S. healthcare system largely don't reward the usage of these tools or any positive outcomes in cost or quality that would result.

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Looking Forward

The U.S. healthcare system is poised for significant change because of pressures associated with rising healthcare costs, uneven quality, and eroding coverage. Delivery system and payment reforms that promise to improve both the quality and the cost-effectiveness of care are rapidly emerging with leadership by both the public and private sectors. Such reforms rely on a strong information foundation that healthcare IT provides. EHRs must continue to adapt to the needs of these new models of care. The demand for robust health information exchange is expected to significantly increase. New delivery models and rewards based on outcomes in cost and quality will depend on—among other things—more activated, engaged, and informed patients, which can be supported by online and electronic tools.

Healthcare IT professionals of the future will need to be able to track rapid changes in healthcare delivery and payment and be able to adapt to address rapidly emerging demands that result from these changes. While the challenges are daunting, the opportunities are considerable. Healthcare IT has the potential of significantly advancing the transformation of the U.S. healthcare system to one that is less fragmented and more coordinated, accountable, and transparent; one that puts the patient in the center; and one that delivers higher-quality, more cost-effective care for all Americans.

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Chapter Review

Information technology plays a significant role in improving the quality, safety, and efficiency of healthcare. Healthcare IT comes in many forms. This chapter described three types of healthcare IT that are predominantly used in the healthcare system today: healthcare IT utilized by clinicians, hospitals, and other providers to support the delivery of care (ordinarily referred to as *electronic health records*); methods by which health information is electronically exchanged across the settings where care and services are delivered (often referred to as *health information exchange*); and electronic tools utilized by consumers and patients to help them manage their health and healthcare.

In addition to a description of these three types of healthcare IT, the chapter provided an overview of benefits, current adoption rates, and barriers to adoption. It also described federal programs designed to address these barriers and offered tips for IT professionals.

Healthcare IT has the potential to lay the foundation for many of the activities that will support the transformation of the U.S. healthcare system to one that delivers higher-quality, safer, more cost-effective care for all Americans.

Questions and Answers

1. Which of the following is a benefit of electronic health records (EHRs)? ?

- A. Efficiency of care
- B. Effectiveness of care
- C. Patient satisfaction
- D. Provider satisfaction
- E. A and B
- F. All of the above

2. Which of the following is a significant driver for the use of EHRs? ?

- A. Rising healthcare costs
- B. Concerns about quality
- C. Concerns about coverage (access to health insurance)
- D. Concerns about inaccurate billing
- E. A and B
- F. All of the above

3. Which of the following is not a key barrier to EHR adoption among physicians? ?

- A. Concerns about privacy and security.
- B. Concerns about financing and ongoing business case.

C. Concerns about the safety of healthcare IT products.

D. Concerns about being able to evaluate, select, and implement a system.

E. All of the above are barriers to EHR adoption among physicians.

4. Which of the following is not a key feature of a "basic" EHR system? ?

A. Patient problem list.

B. Physician clinical notes.

C. Patient billing information.

D. Patient history.

E. Patient demographic information.

F. Laboratory and imaging test results.

G. List of medications.

H. All of the above are key elements of a basic EHR system.

5. Which of the following is not a requirement of stage 1 of the CMS Medicare and Medicaid EHR Incentive Programs? ?

A. Maintain an active medication list.

B. Report clinical quality measures.

C. Implement secure messaging.

D. Record smoking status.

E. All of the above are requirements of stage 1.

6. Which of the following is a commonly cited barrier to health information exchange? ?

A. Lack of a business case for health information exchange

B. Concerns about privacy and security

C. Lack of an infrastructure for health information exchange

D. A and B

E. All of the above

7. Which of the following is demonstrated by more than 75 percent of all consumers? ?

A. Have used a personal health record

B. Have looked online for information about health topics

C. Have used a social media site to share insights on their health or healthcare

D. Have e-mailed their doctors

E. A and B

F. All of the above

8. Which of the following is not an electronic tool by which clinicians can engage consumers? ?

A. Personal health record.

B. Secure messaging.

C. Practice management system.

D. Physician web site and blog.

E. All of the above represent electronic tools by which clinicians can engage consumers.

9. Which one of the following is a key barrier to physicians adopting electronic tools to support the engagement of consumers?

A. Lack of reimbursement for time spent

B. Concerns about privacy and security protections

C. Concerns about liability

D. A and B

E. All of the above

10. Which of the following is a key barrier to consumers adopting electronic tools to connect with their clinicians and other providers?

A. Concerns about privacy and security

B. Inability to access a computer or the Internet

C. Lack of electronic capability of their clinicians or other healthcare providers

D. A and B

E. All of the above

Answers

1. **F.** A comprehensive review of the literature indicates that healthcare IT has achieved positive results in all of the following areas: efficiency of care, effectiveness of care, provider satisfaction, patient safety, and patient satisfaction.
2. **E.** Concerns about rising healthcare costs and uneven quality have driven policymakers to develop and implement laws that promote the use of healthcare IT, including EHRs. While there are also concerns about access to healthcare (insurance coverage) or fraud (inaccurate billing), EHRs have not been identified as a primary solution to these key issues.
3. **C.** Commonly cited barriers to EHR adoption among physicians are concerns about financing; privacy and security; and the capacity to evaluate, select, and implement a system. Concerns about the safety of healthcare IT products has not emerged as a primary barrier to adoption among physicians. On the contrary, evidence indicates that overall healthcare IT has a positive impact on safety by providing clinicians with information that helps them avoid medical errors.
4. **C.** A "basic" EHR is defined as one that includes basic features, such as patient history and demographics, patient problem list, physician clinical notes, comprehensive lists of medications and allergies, computerized orders for prescriptions, and the ability to view laboratory and imaging results electronically. Patient billing information is a common feature or component of a practice management system but not of an EHR.
5. **C.** Maintaining an active medication list, reporting clinical quality measures, and recording smoking status are all requirements of stage 1 for both eligible professionals and hospitals. While secure messaging is proposed to be a requirement for eligible professionals in stage 2, it is not addressed in stage 1 of meaningful use.
6. **E.** Commonly cited barriers to health information exchange among providers include the following: lack of a business case, lack of standards adoption and interoperability, lack of access to infrastructure to support exchange, and concerns about privacy and security.
7. **B.** More than 80 percent of consumers have looked online for information about health topics. On the other hand, adoption rates for personal health records range from 7 to 11 percent. While the use of social media is gaining in popularity, currently only a small percentage of consumers (4 percent) post comments, questions, or information about their health on social media sites.
8. **C.** Personal health records, secure messaging, and a physician web site—which can include a blog—are all electronic tools used by clinicians to engage patients. Practice management systems, on the other

hand, are primarily used for billing and other administrative purposes.

9. **E.** The following represent commonly cited barriers to the adoption of consumer-facing electronic tools by clinicians: lack of a business case or reimbursement for such activities, concerns about privacy and security protections, and in some cases concerns about liability.
10. **E.** Concerns about privacy and security and the inability to gain access to a computer or the Internet are all commonly cited barriers of consumers who are not using electronic tools to engage with their clinicians. Also, the lack of EHR adoption or adoption of other electronic capabilities designed to engage consumers among providers serves as a key barrier. Therefore, all of the listed options represent commonly cited barriers for consumers.

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Chapter 15: Core HIT Functionality

Thomas Payne

In this chapter, you will learn how to

- Describe an electronic medical record (EMR) and what it is used for
- Describe the functionality of an EMR
- Explain how EMRs are likely to change in the future
- Understand how various healthcare information systems interact with EMRs

An electronic medical record is a computing system that contains individuals' medical records and provides rich functionality to support the delivery of care in a healthcare entity. The EMR replaces the existing method of maintaining paper medical records and broadens the scope of medical recordkeeping because it goes beyond this to include many other functions and features that were not possible using paper. However, the EMR does share the same medical legal requirements for documenting and delivering healthcare as paper records.

Most people in the healthcare industry use the terms "EMR" and "electronic health record (EHR)" interchangeably; in this chapter, I will use the term "EMR." It is important to point out that some people make the distinction that EHR represents the record of the patient over many episodes of care in many different locations over the course of their life. In this way, an EHR can be viewed as different from an EMR, which is usually a representation of the record generated and collected in one individual clinic, hospital, or healthcare organization.

I used the term "system" in the definition of EMR because an EMR is not a single computing program but rather comprises many different computing applications and databases linked together to meet the needs of the delivery of healthcare. An EMR is more complex than a single computer program because of these different components and their need to synchronize with each other. For example, there are connections to external systems such as the laboratory, connections to devices and terminal servers used to deliver functionality to the point of care, and many other components. Elsewhere in this book you'll learn more about the complexity of health information technology systems including EMRs. This chapter will concentrate on the specific functionality of EMRs.

In small practices, if there is a clinical EMR, there may also be a practice management system used for registration and scheduling and perhaps a common or separate billing system. In hospitals, there may be dozens of computing systems beyond the EMR. These are interconnected with a network, sometimes using an interface engine. A master patient index and admission/discharge/transfer system may be a separate system or integrated with the EMR. You can find a broader description of clinical computing system architecture elsewhere.[1]

EMR Functionality

Fundamentally, the EMR is the place where everyone involved in a patient's care records and accesses information about the patient. As you have learned, the EMR is much more than a repository: you use its functionality to deliver care. The breadth of EMR functionality varies, but a report from the Institute of Medicine provides additional detail on which this chapter is based.[2]

Health Information and Data

A basic requirement of an EMR is the ability to store notes and review results such as laboratory, radiology, and other testing results. Managing this functionality is more challenging than it might seem because there is so much

medical information relevant to a person's health that clinicians are at risk for missing important information if systems are difficult to navigate or don't contain the entire medical history.[3] Therefore, the display, summarization of patient information, and methods to draw attention to important data are extremely critical to the delivery of care. Without thoughtfully designed methods to store, manage, and display information, the EMR does not serve the needs of the patient well because the information needed is not available in the right place at the right time.

Results Review

Summarization, tables, display of normal ranges and highlighting if results are outside of those ranges, and many other features are important to the success, safety, and efficient use of the EMR. Some data, such as numeric results of a complete blood count, may be amenable to being displayed in a spreadsheet-like format with the ability to view and graph trends. Other results such as microbiology may be best seen and understood in textual reports. Important considerations are whether, and how, to indicate results that are pending but not yet available and how to show microbiology results from specimens that were obtained a week ago but now have results. Figure 15-1 shows an example of a patient information summary screen from an EMR which gives a global picture of the patient's data in summary form, and Figure 15-2 shows an example of a results flow sheet from an EMR which provides trended information on a patient's laboratory results.

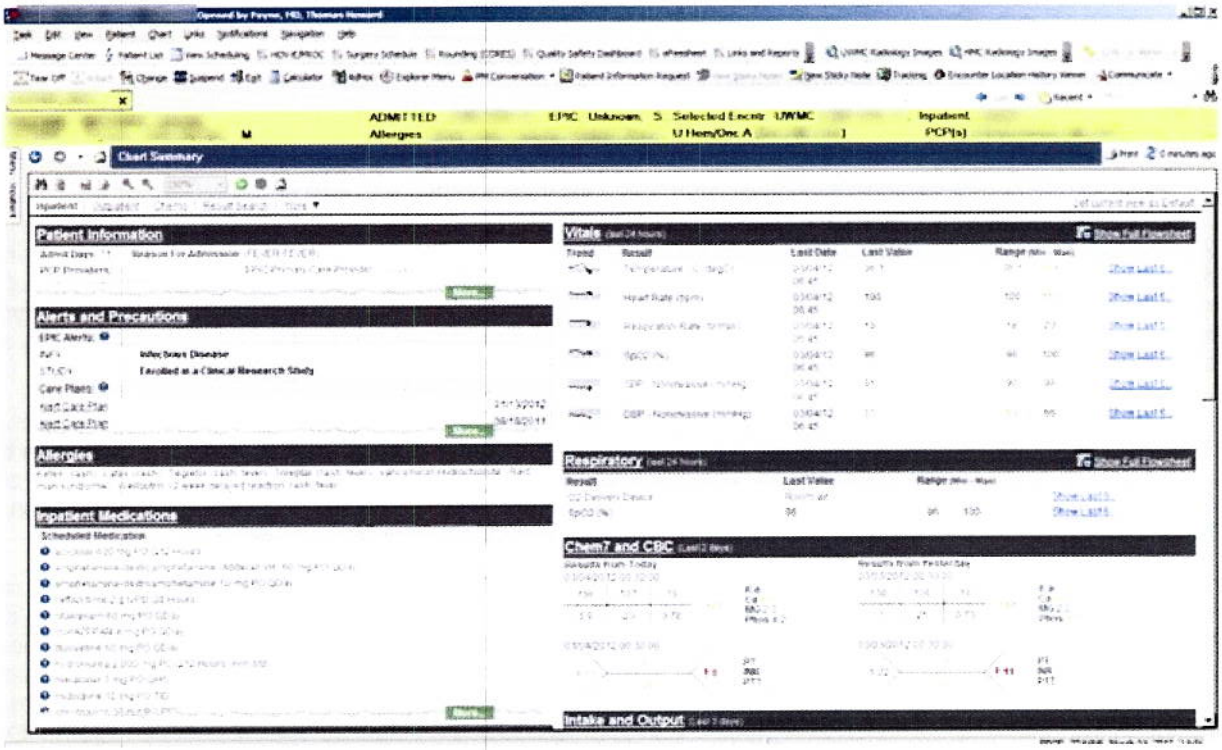

Figure 15-1: Example of a summary screen from an EMR. Reprinted with permission from Cerner Corporation. © 2012 Cerner Corporation. All rights reserved.

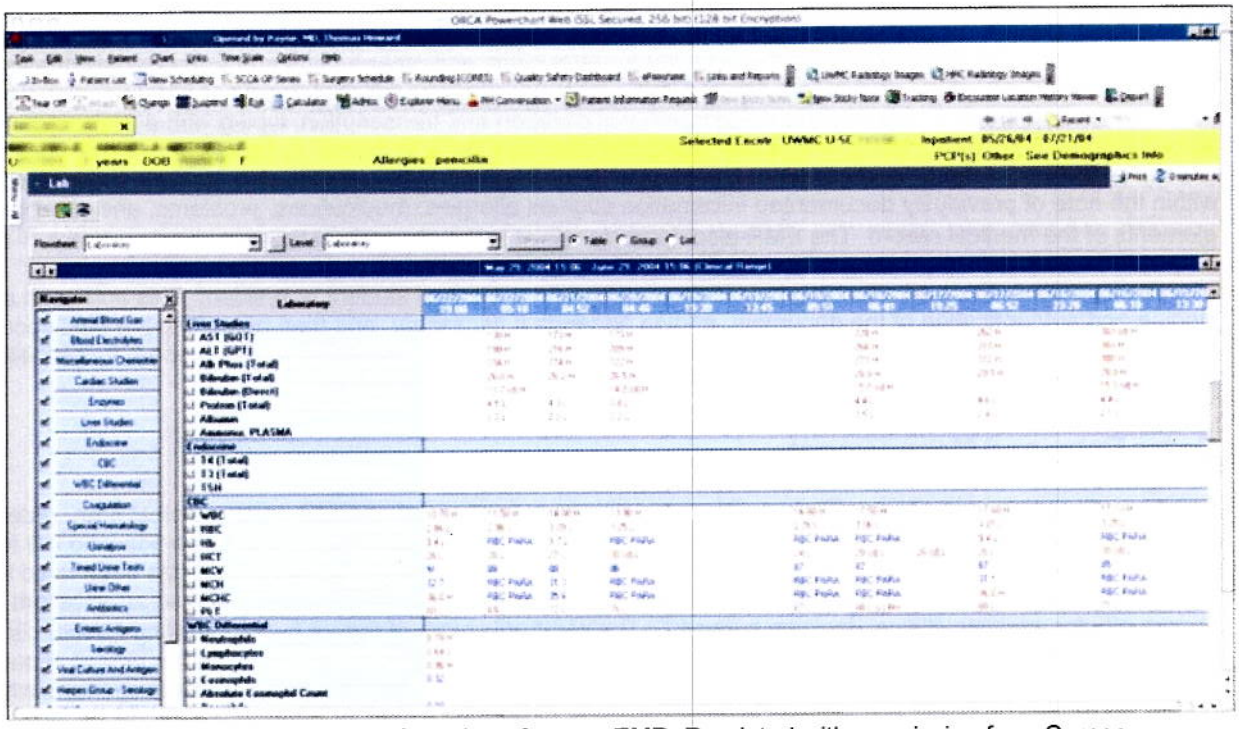

Figure 15-2: Example of a results flow sheet from an EMR. Reprinted with permission from Cerner Corporation.

Results Management

A seemingly basic yet important function of an EMR is results management. In addition to storing and displaying data, most EMRs use a message box (sometimes referred to as an *inbasket* or *inbox*). This functionality draws attention to results that the user may have particular interest in seeing. For example, if the clinician ordered a hematocrit, results of the hematocrit would come back to the user in this part of the EMR. This saves the user the trouble of remembering the test was ordered and finding the results in the chart of the patient. The user can look in the message box to find this result and, if necessary, compare it to previous results for the same patient. The message box is also where notes created by another clinician after a clinic visit or hospitalization can be sent for the user to review. Because there are so many results and documents to review in the course of a busy day, the design, efficiency, and speed of the message box are very important to clinicians.

Documentation

Documentation is one of the most fundamental aspects of the medical record. *Documentation* refers to the notes created during or after an office visit, daily progress notes, procedure notes after an operation or other procedure, discharge summaries for a hospitalized patient, and many other types of notes to document care provided to the patient. Documentation is important because it allows all of the people involved in a person's care to understand what has happened during previous visits and understand what the plans for future care are. If the patient was found to have cancer, there may be a note by an oncologist who recommends a course of care such as chemotherapy, which is carried out in a series of visits. Each of these visits may have a note that describes progress and response to therapy including complications. Over time these documents represent the story of the patient's health, disease, and treatment along with the details that are needed for good care.

Documentation is also extremely important because it is one of the primary mechanisms used for clinician and facility reimbursement for care provided in the United States. It is also an important source of information about the quality of care that was delivered. In short, documentation of patient care is one of the key elements of the EMR.

Some health professionals—for example, hospital registered nurses—may document using forms or a spreadsheet-like format into which patient vital signs, intake and output, or values quantifying a patient's pain level or other measures may be entered. These numeric, or "structured," data fields represent a valuable form of documentation that supplements narrative text, because they make it easy to see trends over time and to quickly ascertain whether treatment goals are being met. Other professional disciplines may also use a table format for their documentation, such as respiratory therapists and physical therapists. One of the values of an EMR is that everyone involved in the patient's care can see the perspective and observations of colleagues from other professions.

EMRs should permit the collection of documents in the record to be read quickly, organized, and sometimes summarized. Equally, or even more importantly, are EMR tools for creating notes. Since the act of documenting care represents a large percentage of the workday for physicians and other healthcare professionals, the speed, efficiency, and clarity of the documents created using them are very important elements of EMR functionality. Methods for documenting care include using traditional dictation and transcription, typing with a keyboard, using voice recognition software, using a template where the user can "point and click" to build a note via a mouse to choose predefined options, and combinations of all of these methods. Many EMRs also facilitate the incorporation within the note of previously documented information such as allergies, medications, problems, and other discrete elements of the medical record. The EMR also needs to assist in the life cycle of the documents within it.[4] Notes may start in draft form, permitting review by the author and, in academic settings, by those who may be overseeing care such as an attending physician working with a medical student or resident. This approach allows signing and authentication of the document, adding addenda if necessary, and then permitting the final document to be communicated electronically or by other means to those whom may need to see it. In short, functionality to document care is one of the most important functional requirements of an EMR.

Order Entry and Management

Entering, managing, and communicating orders are other key features of an EMR. In its simplest form, order entry functionality permits an order to be electronically entered and transmitted to the service or person who will fulfill the order. In reality, the process is usually more complex. The term "ordering conversation" has been used to describe the give-and-take between the ordering clinician and the order recipient, and it is also an excellent opportunity for applying clinical decision support.[5] The electronic entry of orders by the ordering clinician is referred to as *computerized practitioner order entry* (CPOE). The definition of CPOE is that the person requesting the order also enters that order electronically. This distinguishes CPOE from the more common scenario where orders are written on paper and entered into the computer system by a clerk or other assistant. CPOE is one of the most complex and difficult elements of an EMR to design and to implement for many reasons.

- Most clinicians are used to the paper-based process where others clarify and enter complex orders.
- There is a high volume of orders written throughout the care of the patient.
- There is a wide diversity of the orders.
- Order accuracy is critically important (right order on the right patient).

Entering orders for cancer chemotherapy drugs is a good example of this complexity and helps highlight the risks of CPOE if not used correctly. Chemotherapy drugs can cure cancer; however, the margin of error is small, and any amount greater than the recommended dose can be highly toxic. The difference between helping and harming the patient is in part related to the dose given. If an error is made in selecting the appropriate dose, there can be serious implications for the patient.

Medication reconciliation is a hot topic in EMR functionality because it is so important yet can be so time-consuming. The term "medication reconciliation" refers to the review of the list of medications a patient is taking before and after a transition, such as admission to the hospital, at the time of a clinic visit, or at the time of transfer from one level of care in the hospital to another. It is tricky because there may be many medications, and the clinician (usually the physician) has to decide to continue or stop each medication and also confirm with the patient that the lists accurately reflect what is being taken. So, a lot of information is absorbed and acted on in a short time. How long this takes and how logical it is to use the functionality for medication reconciliation is an important factor in whether the clinician is happy with the EMR.

> **Tip** CPOE highlights one of the very important criteria for successfully implementing EMRs: how long it takes to use the EMR is of paramount importance to clinicians. Many clinicians count the number of "clicks" it takes to place an order, and their satisfaction is directly related to that number. If it takes too long or too many clicks to enter an order, write a note, review data, or perform any other function, then clinician acceptance and adoption of the EMR will be impacted. It is extremely difficult to design systems that are safe, accurate, and also fast to use. CPOE functionality is a great example of this challenge.

After orders are written, they are normally immediately available electronically to the laboratory, pharmacy, radiology department, bedside nurse, or other receiving service so that the order can be carried out. There are often additional actions required by the order recipient to clarify or select an alternate order from the original. This is one of the reasons that clinical decision support has the potential to be so helpful, because that feedback or those alternate orders can be suggested at the time the order is being written or immediately thereafter.

Decision Support[6],[7]

This brings me to the topic of decision support. One of the core benefits of CPOE is ensuring patients are not prescribed medications they are allergic to. With CPOE, if there is an allergy to the medication ordered, the clinician can make a correction to the order and select an alternative medication. This can be done with only a minimal delay in treatment. While there are often later stages of the order entry process where the error might be caught (pharmacy or nursing), decision support at the point of order entry facilitates a more efficient process that is less reliant on downstream clinicians who then have to communicate with the ordering provider. Decision support serves an important role to prevent mistakes from happening.[8] More generally, decision support can influence the decision making that leads to orders. For example, if there is a constellation of findings and laboratory results that suggest a certain syndrome, that syndrome can be brought to the attention of the clinician so that it can be considered or further investigated. Other examples of decision support are pop-up reminders to prompt for the delivery of preventive care such as immunizations, cancer screening, laboratory tests to monitor drug treatment, and many other needed interventions. Clinical decision support is even broader than this. A template for writing a note can be thought of as a form of decision support because the template might include prompts to gather information when taking the history from patient. Links to external references that can supplement the clinician's knowledge of a condition is another form of decision support.[9] Clinical decision support is a very broad topic and is one that has received considerable attention in the medical informatics community. It is also a key element of EMR design and can be found in many areas of functionality of the EMR.

Electronic Communication

Healthcare is rarely delivered by one single person but by people working together in teams. The interaction and communication among the people working together to support a patient are extremely important. When the patient receives less than optimal care, the cause can often be traced to a problem or breakdown in communication. How an EMR handles the creation and routing of electronic communication is yet another key component of an EMR. (This includes communication with the patient—more on this in the following section.)

Communication can be supported in a variety of ways. There may be features to send messages that are analogous to electronic mail but securely within the confines of the EMR. This permits one person on the care team to send a secure message to another. Other communication tools include the ability for a patient or a referring physician to use web-based access to review results or reports. Usually when a web application is used, there are provisions for the clinician who ordered the test to offer comments on the results or reports they interpret such as "These are improved from last time" or "We need to discuss these results. Please make an appointment."

Use Case 15-1: Improving Medical Care in an Emergency Situation

This use case provides a "real-life" example of how EMRs can directly support and improve medical care in an emergency situation.

A 47-year-old male was brought to a medical center by helicopter after extraction from a car after a high-speed motor vehicle accident. Paramedics on the scene and during transport had access to his medical history through a radio link with an emergency room physician who accessed the patient's EMR. Knowledge that the accident victim had received a bone marrow transplant for lymphoma three years ago, including which medications he was allergic to, permitted in-field treatment and allowed him to be safely given blood products appropriate for his needs soon after he arrived in the emergency room. Information on who had treated him and where, his surgical history, and other information was immediately available through the EMR. Decision support through CPOE alerted clinicians to prescribe safely when minutes were critical. Notes written during and after resuscitation in the emergency room and his computed tomography (CT) scan images were available 30 minutes later to surgeons in the operating room. The patient's EMR record stacked the odds in his favor. After recovery, the entire record was available to his surgeon and oncologist in the clinic.

Administrative Processes

There are considerable administrative burdens related to the delivery of care including billing, tracking insurance coverage, auditing the record, and many other requirements. Each of these is a complex area and may be handled by separate modules or software apart from the EMR. However, the EMR should be able to support these requirements and others. For example, in the United States, payment for care includes a professional fee

charged by the physician or other practitioner and a facility charge. Both have well-documented requirements, regulations, and laws that govern them. The EMR needs to support these requirements so that appropriate reimbursement can be received. These include, but are not limited to, tracking appointments and encounters, keeping up with insurance coverage changes, completing documentation, generating reports needed for measuring and improving quality, and meeting regulatory requirements. Both facilities and clinicians run the risk of audits and other legal actions if the EMR does not support their charges.

Population Management

While patients are usually seen one at a time, considerable care and education can be delivered more efficiently to a collective group of patients. The practice team or physician may have the responsibility to manage the care of a collection (or population) of individuals. A population may be defined by the practice that serves them or by a condition they share, such as diabetes mellitus. The ability to view and manage the defined population of patients and see how the plan of care has been adhered to by each of them is becomingly increasingly important. Some but not all EMRs support population management to various degrees.

Providing population management includes tools such as registries (lists of patient with common characteristics and tools to manage their care), plans of care, the ability to query to see who has a condition or might be taking a certain medication and needs intervention, and finally teams organized to deliver care.[10] As methods of reimbursement for healthcare change, it is likely that practitioners will be at risk for the care of groups of patients and that reimbursement will be tied to this rather than solely linked to the delivery of service for one patient at a time.

[1]Payne, T. H. (2008). Practical guide to clinical computing systems: Design, operations, and infrastructure. Elsevier.

[2]National Research Council. (2003). Key capabilities of an electronic health record system: Letter report. National Academies Press.

[3]Schiff, G. D., & Bates, D. W. (2010). Can electronic clinical documentation help prevent diagnostic errors? *New England Journal of Medicine, 362*, 1066–1069.

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[5]Bates, D. W., Leape, L. L., Cullen, D. J., Laird, N., et al. (1998). Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. *Journal of the American Medical Informatics Association, 280*, 1311–1316.

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[7]Lyman, J. A., Cohn, W. F., Bloomrosen, M., & Detmer, D. E. (2010). Clinical decision support: Progress and opportunities. *Journal of the American Medical Informatics Association, 17*, 487–492.

[8]Kuperman, G. J., Bobb, A., Payne, T. H., Avery, A. J., Gandhi, T. K., Burns, G., Classen, D. C., & Bates, D. W. (2007). Medication-related clinical decision support in computerized provider order entry systems: A review. *Journal of the American Medical Informatics Association, 14*, 29–40.

[9]Cimino, J. (2008). Infobuttons: Anticipatory passive decision support. *American Medical Informatics Association Annual Symposium Proceedings*, 1203–1204.

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Support of the Patient/Person

It is widely understood that the true owner of the information contained in the electronic record is the person. Healthcare institutions are custodians of the EMR, and every person has a right to view their own record. With paper-based charts, the challenge has been the cumbersome sharing of, and associated expense of copying for, both patients and other clinicians to have access to the record. EMR features can help address this. For example, using a secure web link, patients can be permitted to view certain sections of the medical record such as results and to send messages to their care team. More broadly, there may be functionality to permit the patient to schedule appointments; read about their condition from a credible source; be reminded of tasks, tests, or other activities that are important to their health; and receive support from peers or others with the same condition. Social networking features are new to EMRs but hold promise just as they do in other aspects of our society. I do not discuss personal health records in this chapter, but you are encouraged to learn more about them.[11]

There are varying views and questions regarding how patients should be involved with their own record.

- Should patients view the entire record in real time as it is created?
- Should the creation of a progress note be a cooperative process?
- Who besides the patient could or should have access or contribute?

These, and many others, are the important questions that are being investigated. Many feel that the record is the property of the patient, and creation of the permanent record should include the patient. There is interesting research about a first step toward this goal, which is to permit the patient access to see parts of the record just as the doctor does. While this seems to be common sense, in reality making it simple for patients to see their own record is somewhat controversial. Support of the patient by the EMR is an area that is growing rapidly.

[11]Steinbrook, R. (2008). Personally controlled online health data: The next big thing in medical care? *New England Journal of Medicine, 358*, 1653–1656.

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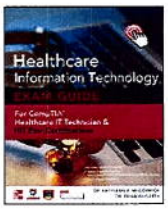

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Other Health Information Technology Systems Commonly Used Within Healthcare Organizations

Though the EMR is the central healthcare IT system used in most healthcare organizations, frequently many other systems that interact with the EMR are also used to support the organization, particularly in hospitals and large organizations.

The *admission, discharge, transfer (ADT) system* tracks the location and movement of patients within an organization and communicates with the EMR and departmental systems, conveying information on bed, hospital ward location, care team, attending physician, and other information. They may be separate systems connected to the EMR using HL7 interfaces or may be integrated with the EMR and with the registration system.

The master patient index (MPI) may also be a separate system or integrated with ADT, with registration, or with the EMR. The MPI serves the critical role of establishing the identity of the person within the healthcare IT system, including and especially the EMR. Names, name spelling, and electronic identifiers used in the EMRs and departmental systems may vary, but it is critical that all data be tied to the correct individual to avoid duplicate records for the same person or erroneously including results for two people in one record.

Departmental systems often exist for radiology, the clinical laboratory, pathology, and many other departments. The departments, also known as *ancillaries* or *essential services*, are often very large and complex with information management needs met by one or more specialized departmental systems. For example, in radiology there may be a *radiology information system (RIS)* to manage scheduling, imaging reports and other operations, and a *picture archiving and communication system (PACS)* to manage images. The laboratory may have separate systems for chemistry, hematology, microbiology, and other roles or a single laboratory system for all of these and more. Most pharmacies depend heavily on automation; *pharmacy systems* may be further divided between inpatient pharmacy, retail (or outpatient pharmacy), inventory tracking, and other systems, or the organization may have a single pharmacy system to meet all of these needs. The financial and quality function of a healthcare organization likely has its own computing systems for assigning codes to a hospital stay and submitting both facility and professional fees to payers. *Decision support system (DSS)* applies to a wide variety of functionality to aid in business, strategic, clinical, quality, and research decision making. With growth in healthcare IT, DSS systems are growing rapidly.

There may be many other systems within a healthcare organization. The overall design and architecture of healthcare IT systems are for this reason extremely important so that information can be communicated between them as needed, their functionality is fully leveraged, and organizational and national standards are maintained for the data they contain. The architecture of organizational healthcare IT is described elsewhere in this book.

CompTIA Exam Tip The concept of patient tracking at first blush seems almost silly. Don't healthcare professionals know where their patients are at all times? You would be surprised. In today's fast paced and multifaceted ambulatory and emergency settings, and even some inpatient settings, patients move from room to room, are sent to receive a diagnostic image, or need to be quickly found by a technician or phlebotomist. For example, the ADT (Admission, Discharge, Transfer) module of an EHR tells us Ms. Jones is on 4SE in room 321 bed 2, but patient tracking software can tell us that right now she is in the radiology department for her CT. That detail of tracking information can be invaluable for nurses and other staff. Other ways patient tracking software can help is by assisting the healthcare worker to determine things such as room availability, patient checked-in or registration

status, treatments ordered, why the patient is waiting excessively, and more. This class of software facilitates decreased waiting times in emergency rooms and other desirable healthcare organization efficiency outcomes.

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Frequently Asked Questions

The following are answers to frequently asked questions.

What Does CPOE (and CPOM) Stand For?

CPOE stands for computerized practitioner (or provider) order entry. The *p* stands for practitioner or provider rather than just physician, because licensed practitioners, nurses, and pharmacists can also enter orders. Another acronym occasionally used is CPOM, where the *m* stands for management, not just entry, of orders. Actions such as modifying, suspending, and discontinuing orders are often as important and more complex and challenging than order entry.

When a Pop-up Alert Is Overridden, Does That Mean It Wasn't Useful?

Many studies have shown that override rates for pop-up alerts during CPOE are particularly high. However, just because an alert is overridden or ignored doesn't mean the alert didn't help the ordering practitioner. Although the order may not be canceled or changed because of the alert, the practitioner may elect to more carefully monitor the patient or to take actions that otherwise would not have occurred. So, override rates don't tell the whole story.

Are There Limits to a "Best-of-Breed" Strategy?

Rarely will an organization buy all clinical and financial systems from one supplier, and most organizations rely on interfaces to connect multiple systems. However, most experts recommend that at a minimum the CPOE pharmacy and medication administration systems share a single platform from the same vendor, at least for inpatient care. Sometimes referred to as the *medication process*, medication order entry, pharmacy verification, and nursing administration are so closely linked and interdependent that multiple interfaced systems present significant challenges and risks.

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Roles and Professional Background of People Working in Healthcare Organizations

There are many healthcare professional roles active in even a moderately sized hospital or a large physician office practice. The following are just a few key professional roles with brief descriptions of each role.

Physicians

Physicians are doctors of medicine (MD) or osteopathy (DO) who have graduated from medical school. Following medical school, they almost always serve as an intern for an additional year and then as a resident for two years or longer beyond internship. (The first year of residency is often referred to as the *internship*.) Medical doctors must be licensed to practice, and many of them take additional exams for board certification. They may also be authorized to prescribe controlled substances such as narcotics. They need to have privileges to practice in the hospital, and the privileges are tied to their training and experience. Physicians often specialize in their training to become family practitioners, internal medicine physicians (internists), obstetricians, surgeons (general, orthopedic, cardiovascular, urology, and many others), or one of numerous other specialties. (Don't confuse internist with intern—the former is a specialist in internal medicine, while the latter is someone in the first year of residency.)

Registered Nurses

Nurses are graduates of a nursing school who have been granted the degree RN. They may also have a bachelor's or master's degree in nursing. Nurses serve in a wide variety of roles, including providing bedside care in the hospital, quality manager, clinical unit supervision, triage and advice, and other forms of direct patient care. They may have additional degrees to become an advance practice nurse such as an ARNP, permitting them to practice in a role similar to that of physicians including having prescriptive authority.

Physician Assistants

Physician assistants (PAs) practice in association with physicians and in general serve to extend the services that the physician delivers. They may be fairly independent with periodic oversight, or they may work in very close connection with a physician (e.g., the operating room working with an orthopedic surgeon). As is the case of ARNPs, they may have prescriptive authority and are important members of the care delivery team of a hospital, clinic, or other healthcare organization.

Medical Assistants

Medical assistants (MAs) have received specific training to help with many tasks within a clinic or hospital. They are frequently the first clinical person patients encounter in the healthcare system and are often tasked with collecting and documenting vital signs, allergies, and other basic information needed for patient care, as well as providing patients with information or facilitating patient flow. They work closely with registered nurses, physicians, and others in the clinic or hospital. They do not have prescriptive authority and typically don't have the degree of training nurses and physicians have.

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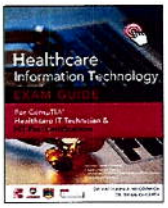

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Unique Considerations of Academic Roles

Those who support healthcare IT in academic settings face challenges that are not as prominent outside academia.

- The most obvious is that training is a continuous process in every discipline—medicine, nursing, pharmacy, and many other healthcare fields. Training programs must be part of regular clinic and hospital operations, and support systems that complement training must also be tailored to this constantly changing workforce. The various roles within an academic environment have different licensing, prescribing, and documentation privileges. EMRs must support this wide variety of roles, which change over time.
- Academic practice includes research: the cycle of posing questions, receiving approval to conduct trials, applying for funding, and carrying out the research study. EMRs must support research both directly (for example, by flagging orders and notes to be sent to different research payers and informing users that a patient is involved in a research study) and indirectly (for example, by supporting use of data extracted from clinical systems and EMRs to be used by investigators who have received institutional review board approval to do so).

Research about informatics is now common in academic settings. In fact, much of what we know about the benefits, risks, and "unintended consequences" of healthcare IT comes from academic informatics programs. As has been the case for other new fields, it is by studying the use of healthcare IT and patient outcomes attributable to it that you can learn what it can and cannot be expected to do. You need to retain an open mind about healthcare IT in the early stages of use and in the years to come.

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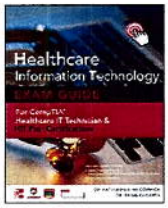

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Chapter Review

EMRs are more than just replacements of paper medical records. They permit viewing, summarizing, and creating key data used in the care of patients, and they permit the delivery of care through the entry of orders and in other ways. Their functionality and ease of use helps determine the safety, efficiency, and ease of patient care. Thus, they are critically important elements in modern healthcare. They are no longer the domain of just doctors and nurses: nearly everyone on a care team, including the patient, participates in creating and using the EMR. Understanding how they work, their strengths, and future enhancements is key to success in clinical informatics.

Questions and Answers

1. Patients are legally entitled to see test results, discharge summaries, and operative notes but not the text of physician progress notes unless the physician agrees. ?

   A. True

   B. False

2. Which of the following is considered by the Institute of Medicine to be functionality in an electronic health record? ?

   A. Results management

   B. Population health management

   C. Administrative support

   D. Communication tools

   E. All of the above

3. Though nurse practitioners and physicians assistants are active members of the healthcare team in many organizations, the Health Insurance Portability and Accountability Act (HIPAA) of 1996 does not permit them to write prescriptions. ?

   A. True

   B. False

4. Why is proper documentation in an EMR important? ?

   A. It helps the insurance company know how to charge the patient.

   B. It lets the patient know what care they received in an emergency department.

   C. It allows all of the people involved in a person's care to understand what has happened during previous visits and see what the plans for future care are.

   D. It provides the family of a patient access to a family member's medical record so that they can better care for their family member.

5. The electronic entry of orders by the ordering clinician is referred to as which of the following? ?

   A. Online entry system (OES)

B. Computerized practitioner order entry (CPOE)

C. Computerized ordering (CO)

D. Medication ordering system (MOS)

6. What does medication reconciliation refer to?

A. A pharmacist substituting a generic medication for a brand-name medication when filling a doctor's order

B. The hospital and insurance agency agreeing on a fair price to charge patients for a medication

C. The review of the list of medications a patient is taking before and after a transition, such as admission to the hospital

D. Letting patients decide which medications they want to take

7. What critical role does the master patient index (MPI) serve?

A. Establishing the identity of the person within the healthcare IT system, including and especially the EMR

B. Tracking the location and movement of patients within an organization and communicating with the EMR

C. Letting the nurses and physicians know which patients they are responsible for at the start of their shift

D. None of the above

8. When a pop-up alert is overridden, it means it wasn't useful.

A. True

B. False

Answers

1. **B.** Patients can see their entire medical record.
2. **E.** Results management, population health management, administrative support, and communication tools are all considered to be key functions of an EMR.
3. **B.** False. Nurse practitioners and physician assistants are permitted to write prescriptions.
4. **C.** Proper documentation in an EMR is important because it allows all of the people involved in a person's care to understand what has happened during previous visits and see what the plans for future care are.
5. **B.** The electronic entry of orders by the ordering clinician is referred to as computerized practitioner order entry (CPOE).
6. **C.** Medication reconciliation refers to the review of the list of medications a patient is taking before and after a transition, such as admission to the hospital.
7. **A.** The master patient index (MPI) serves the critical role of establishing the identity of the person within the healthcare IT system, including and especially the EMR.
8. **B.** False. Just because an alert is overridden or ignored doesn't mean the alert didn't help the ordering practitioner.

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