Chapter 6

Ambulatory Systems

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INTRODUCTION

When looked at from the patient’s perspective, the ambulatory electronic health record (AEHR) is probably closer to the patient’s archetype of “my chart” than its acute care sibling.

Nevertheless, the erstwhile second-class status of the AEHR stems from the socio-economic history of the EHR. The EHR was born in large, acute care institutions, largely to serve hospital-based providers. Their view, as dictated by reimbursement methods, was encounter-based and focused on procedures and hospital stays. The notion of a single patient flowing through a series of complex encounters across providers over years was absent. So the hospital care delivery flows seemed to take on a disproportionately large role relative to the caretaking place outside it. This view was amusingly captured by Carter in a comparison to inpatient EMR implementations: “Ambulatory care sites tend to be simpler.”1

The last several years suggest that the perspective on EHRs is changing. In 2005, the HIMSS Ambulatory Care Initiative identified two key trends that point to the centrality of the AEHR (see Figures 6-1 and 6-2).2

First is the imbalance in the scale of ambulatory encounters, which are counted in the billions, compared to acute care encounters which are counted in the millions (1.2 billion versus 34 million3). Second, ambulatory healthcare expenditures have surpassed acute care expenditures and continue to grow more quickly. The nation spends about 1/10th as much on ambulatory IT as it does on inpatient-based systems.2 But with the critical importance the Obama administration has placed on the EHR as a tool for reforming healthcare, more physician offices have been incentivized to adopt AEHRs and discouraged from staying with paper.4,5

In this chapter, we will explore how the AEHR differs from its inpatient counterpart by focusing on the key functions and workflows it supports. We will examine key executive considerations such as cost, return on investment (ROI) and infrastructure. The chapter closes with a discussion of the status of the industry and where it appears to be headed in the future.
HIMSS defines the EHR as follows:

The Electronic Health Record (EHR) is a secure, real-time, point-of-care, patient-centric information resource for clinicians. The EHR aids clinicians’ decision making by providing access to the patient health record information where and when they need it and by incorporating evidence-based decision support. The EHR automates and streamlines the clinician’s workflow, closing loops in communication and response that result in delays or gaps in care. The EHR also supports the collection of data for uses other than direct clinical care, such as billing, quality management, outcomes reporting, resource planning, and public health disease surveillance and reporting.

While this academic description covers the waterfront, the marketplace boils it down to three categories of systems: practice management systems (PMSs), clinical systems, and biomedical devices. We will examine each category, then briefly consider infrastructure. We will start with practice management system because it is the first system any practice should be implementing (or will need to implement simultaneously with clinical systems). The axiom, “no money, no mission” is certainly applicable in ambulatory medical practices. Clinical systems and biomedical devices are more glam-
orous and dynamic. Though perhaps the least sexy of all, infrastructure considerations are the foundation for all systems and critical in an ambulatory context.

**PRACTICE MANAGEMENT SYSTEM**

A practice management system (PMS) focuses on two interrelated concepts: patient flow and the revenue cycle. These are the operational and financial sides of the same coin. They are the outpatient cousins to the inpatient ADT (admit discharge transfer) and patient accounting systems.

Whether you view the PMS through an operations lens or a financial lens, the business begins with patient identification. It is from this starting point the divergence with inpatient systems begins. The concept of “registration” is very different between the inpatient and outpatient world. The conceptual difference is permanence. The ambulatory world treats registration as a persistent beginning to a lifetime record. Patients see their physicians over and over, but they only register once; they reasonably expect their physician to remember them. In the inpatient world, registration is the beginning of a finite stay and is repeated with each admission. Inpatient EMRs may share demographics across stays, but the patient’s chart, in many systems, is broken up by hospital admission rather than being a continuous record.

From a systems perspective, the difference is the combination of three related functions: identification, registration and scheduling. Patient identification is increasingly the realm of specialized systems specific to the task known as the electronic master patient index (EMPI). These systems contain a database with a very small amount of identity and demographic data about every patient in their dominion. The job of the EMPI is to make sure that each patient has only one set of data (e.g., first name, last name, birthdate, address, phone number, Social Security number, and insurer), even across multiple systems, specialties, locations and institutions.

Almost all PMSs have some EMPI functionality built in. Large PMSs tend to have more sophisticated functionality. A caveat for executives shopping for a PMS is to make sure this functionality is sophisticated enough to meet your needs or that the system is capable of taking direction from an external EMPI, which is increasingly the preference of large organizations. Too many PMSs are designed with the assumption they are in charge of patient identity, which can lead to significant difficulty when trying to integrate with other systems.

The details of patient identification can be mind numbling, particularly to those who fail to grasp their importance. But ignore them at your peril. The ambulatory world can be deceptively simple in this regard. If you view each practice independently it may be easy to keep a few thousand patients straight without a large number of duplicates. But when you combine practices or try to combine data from patients across practices, you quickly realize that the ambulatory world is very large indeed. The lack of a single identifier makes matching logic more critical. And the well-documented failures and risks of using Social Security numbers make the task ahead look even more challenging.\(^7,8\)

Once the patient is identified, the formal registration can begin. This is the collection of deeper patient demographics, including insurance coverage information, emergency contacts, customer service information such as contact preferences and similar
Scheduling

In the inpatient world, the process now moves to bed management while in the outpatient world the next job is scheduling. Because patients are admitted to the hospital at a particular time and date, scheduling is inherent in the admission process. For the ambulatory patient, all future encounters will key off the original registration (generally with registration data confirmation and/or necessary updates), and the schedule is the focus of new encounters.

Because the process of scheduling is so tightly linked to registration, it is not surprising that many clinical scheduling systems are integrated with registration systems within the PMS. There are a few key qualities of ambulatory scheduling that differentiate the various systems available on the market. Perhaps the most important is how they differ from non-clinical scheduling systems such as Microsoft Outlook™—which for clarity are referred to here as calendaring systems.

Calendaring systems have been and continue to be used to schedule patient visits/services in the ambulatory context. The main distinction between a scheduling system and a calendaring system is the linkage to the patient record. In a typical business calendaring system, the user cannot quickly locate a whole history of a given patient's appointments, or sort them by type. The appointment is usually free text, whereas in a clinical scheduling system the appointment is with a specific patient already registered in the database.

Clinical schedules are also linked to billing encounters. This is critical from the financial perspective. One of the first interventions in a typical revenue cycle enhancement program is to match charges against the schedule. This is possible manually with a calendaring system but can be made into an automated “missing charge report” in a clinical scheduling product. Another way of looking at this is that the schedule can define the encounter for the billing system.

Clinical scheduling systems typically support complex templates and rules to maximize patient flow and appointment availability. Concepts such as appointment type, bump lists, freeze and thaw, recurring visits, and team care will have variable importance in different practices and specialties. For example, patients on specific chemotherapy protocols or physical therapy routines can be extremely complicated to schedule. Sophisticated clinical scheduling systems can offer appropriate searching algorithms and decision support that can span visits or include resource availability.

Resource linking is particularly critical in procedural areas. For example, in specialties with endoscopes, the availability of the scope itself and the time needed for sterilization must be accounted for by the scheduling system to maximize throughput. Linkage to materials management systems may also be important for inventory and cost controls.

In academic environments, there are complex regulatory rules that must be accounted for to allow compliant billing. For example, the 1969 CMS IL372 supervision regulations require that primary care supervisors oversee no more than four residents.
at a given time. Without that ratio, the supervisor cannot bill for his or her supervision. Similarly, patients may be part of a clinical trial protocol, and therefore communication regarding a research visit with a clinical trials management system may be important.

Increasingly the most sophisticated practices are providing online access to schedules, with some self-service for patients through Web portals. This is actually not that technically challenging but can interfere with other process controls a practice may have in place. Patients cannot know about complex resource issues, and managed care pre-certifications also can impede delivery of this popular convenience. These barriers can be overcome by enabling patients to request an appointment, which is then managed by scheduling staff or a designated ‘health coach.’

The most sophisticated practices use their scheduling systems to track all aspects of clinical workflow. Some systems can parse a variety of wait times, such as time-to-room, time-in-room, time-with-RN and time-with-MD. Some systems use radio-frequency identification (RFID) or other technologies to automate this, though that is hardly mainstream. When used well, these tools provide practice administrators and clinicians the necessary data to optimize patient flow, maximize resource utilization and improve patient satisfaction.

**Billing**

The core of most PMSs is the financial component. The tools needed to manage billing and accounts receivable are enormously varied due to the wide variety of reimbursement rules and methods throughout the country. The key difference with inpatient systems is the focus on professional fee billing rather than facilities fee billing. One important, and possibly counter-intuitive, feature this may imply is the need for the ambulatory PMS to support inpatient professional billing. Physicians who see inpatients and do not bill “globally”, or through the hospital, send their bills from their office. Therefore, certain types of integration with the inpatient system, such as an ADT interface, may be desirable.

Executives attuned to the current regulatory environment will note the need to synchronize the facility and the professional fee bills in terms of procedure and diagnosis. Given that two staffs, with two different managers, following two sets of rules, using two different systems are responsible for this suggests that it will be fraught with peril. Adding further complexity, multiple specialists may be billing for the same case (e.g., surgery and anesthesia), and different coding systems may be required (e.g., HCPCS and CPT). At this point, few of the systems on the market today are facile at this kind of cross-provider billing reconciliation. If pressure increases toward “global billing” or “bundled payment,” hospitals and doctors will be forced to coordinate to unify their bills and determine how to split the fees. This will create new challenges for sites without integrated billing systems.

Today’s financial systems put increasing emphasis on capturing data as early in the encounter as possible. The shift from back office to front desk is a major component of revenue cycle enhancement projects. Many systems now automate charge capture at the point of care. There are significant opportunities for both revenue enhancement and cost control by automating this step. Costs fall if you can eliminate charge entry clerks, and revenue rises when the computer helps to appropriately code clean claims.
There is an important architectural decision point here. Should the “encounter form” data (a.k.a. super-bill) be entered into a clinical system or a practice management system? The IT manager who is blind to the actual workflow will generally prefer direct entry into the PMS. Entry into the clinical system will require an interface into the PMS (unless they are the same system).

Understanding the workflow is the key to resolving this question. Most physicians will have little or no need to use the PMS. Therefore, if you want the provider to capture the billing data, it may make more sense to capture it from within the clinical system. Ideally, the billing codes fall out of the documentation, in which case the issue is moot. As discussed next, this remains an ideal more than a reality.

In the past decade, some practices started using PDAs (personal digital assistants) or smartphones to capture charges. These systems may be stand-alone or integrated with a PMS or clinical system. Regardless of the platform, these systems offer another way to eliminate paper encounter forms and capture data more accurately and directly into the billing system.

ROI from these systems stems from the reduction in lost charges and reduced service to posting lag. As such, their value is largely based on the relative inefficiency of whatever paper-based system is in place. Executives need to be cautious when evaluating such systems. Their value is only in capturing revenue that was otherwise never captured or on the time-value of money that was captured late. In some cases, that may be quite large, but it may also be fairly modest where paper systems work well.

In many environments in which part-time clinical employment is the norm, the value may be further mitigated by vendor fees that do not acknowledge the less-than-full-time use of the system. Conversely, in consultation-rich specialties, such systems can be a godsend of convenience to physicians, particularly if they practice in multiple locations. These systems are not needed if the inpatient clinical system can capture the charge and send it to the professional fee billing system. This is usually more convenient for physicians, but hospitals may not have an incentive to build these features if the physician bills separately.

Another nuance executives need to beware of is the definition of the encounter itself. As with registration, terminology here is imprecise and can be confusing. Some prefer to refer to the billable event as the encounter and the face-to-face meeting with the patient as the visit. But the increasing prevalence of phone, Web, and other virtual “visits” makes this topic inherently fluid. Regardless of the term you use to refer to the event, the system must know the rules for the definitions, which are generally determined by the payer and may or may not make sense to the clinician. For example, a nine-month pregnancy may be a single encounter with multiple visits. Similarly, a visit to a physician’s office that results in referral to the emergency department may be combined as a single encounter (the “72 hour rule”). A visit to multiple physicians on a single day may be considered a single encounter. The billing system needs to understand these rules. Again, cross-institutional reconciliation may be necessary to ensure complete accuracy in some scenarios.
Managed Care
The most fundamental distinction among practice management systems is support for the various forms of managed care. Practices that take on capitation without a PMS that is fully capable of tracking expenses and supporting risk management are almost certain to fail. Such systems are complex to properly set up and maintain, even when backed by billion dollar insurance companies, which goes a long way toward explaining the falling popularity of this form of reimbursement.

While traditional fee-for-service still exists in some form in most markets, some permutation of managed care is the norm in most areas. While the technology to support managed care exists, it is still very poorly implemented by many PMS vendors. This is, no doubt, in part because few insurance companies support the technology.

The key technologies to support managed care are electronic data interchange (EDI) and robust master file management. The diversity of payer rules, the frequency of changes to the rules, and the frequency with which patients change payers essentially necessitate that providers check eligibility and authorization prior to any service. Despite federal pressure to support EDI, this remains far from ubiquitous.

Many PMS vendors partner with EDI clearinghouse vendors to simplify their own EDI communication. The concept is that providers only need to communicate with one company, which communicates with all the payers on their behalf. Conversely, the payers only need to communicate with a few clearinghouses rather than thousands of providers. The intermediary is therefore more important to the payer than the provider, particularly if your PMS strictly adheres to the transaction protocols.

In theory, Internet standards should allow for direct payer-provider communication. Particularly for large providers, the clearinghouse should not be necessary. Similarly, for small providers who purchase PMS services from a larger entity, such as software as a service (SaaS) or an application service provider (ASP), the clearinghouse should be optional, particularly in the increasing number of markets with very few payers. Payers often mandate the use of a clearinghouse. Further, many vendors charge large transaction fees, which can cut into already slim margins. This practice certainly violates the spirit of laws intended to simplify healthcare communications. Absent stronger regulatory enforcement, inexpensive dis-intermediation will be resisted by the clearinghouses. Executives should pay attention to this issue going forward, as significant efficiencies will be won or lost depending on how the issue of clearinghouses develops.

Claims Editing and Submission
Once the encounter is captured, the next layer of system functionality is charge editing. In many instances, charges may be clean at the point of entry and can quickly flow to the payer. In many other settings, charges must be analyzed for exceptions, discounts, consistency with other claims, the addition of modifiers or other interventions management may want to make before sending the claim. In some systems, these edits can be done in real time and the provider or charge entry staff advised to make changes immediately. In others, the claims are batched and analyzed in bulk. A list of exceptions is created and worked over time.
The goal of editing is to ensure that every claim that is sent to the payer is a clean claim. Sophisticated PMS vendors provide tools that mimic the adjudication rules used by payers and alert the provider to impending rejections before the claim even goes out the door. Clean claims mean no rejections, faster payment, and reduced re-processing costs. Not surprisingly, claim editing is another frequent focus of revenue enhancement efforts. When analyzing the financial return from these efforts, it is important to consider who will be making the charge edits; a highly paid physician or a lower paid biller. This is not to imply that these two efficiencies are necessarily either-or. However, individual workflows need to be well understood before assuming cost reductions. Revenue enhancement may not cut costs and vice versa.

Once through the edit process, a claim is ready to be sent. The ability to print a paper claim remains a requirement of any PMS—if for no other reason than downtime at an intermediary. But most claims today are sent electronically. This may be via a clearinghouse or directly. In either event, logs of the transactions are essential to avoid disputes over lost claims.

The payer now adjudicates the claims, and if a flaw is found the claim is rejected. Here again, there is an opportunity for efficiency if the payer communicates the rejection electronically. Many companies still send rejections via paper. Well-managed practices key these rejections into the PMS with their often obscure rejection codes, so that practice administrators can track the reasons for rejection over time and correct any systematic problems that emerge.

**Master File Management**

This brings us to the second key technology for supporting managed care: strong master file management. All information systems use a variety of tables and dictionaries to drive the lists and other user interface elements customized to your location or practice. For example, a list of physicians you commonly refer to (or are sent referrals from) is one such provider dictionary. In the world of managed care, keeping track of who is “in plan” and “out of plan” is a major problem. Many providers who have dropped out of plan will tell you that it may take months or even years for their name to disappear from the payer’s list, particularly if they are in a shortage specialty.

IT managers are vexed by the need to provide users with accurate data without good sources for the data. Management of referring provider libraries is a good example. This issue is relevant to claims adjudication because of the many nuances of billing that require accurate look-up tables. For example, specialists may need to indicate the license number of a referring physician on the claim or it will be rejected. Therefore the easiest path to clean claims would be a clean dictionary of referring providers.

Many vendors offer portions of these data for sale. But their accuracy may be suspect, and they often lack key information needed to match existing data. States may have good data but often refuse to provide it in a usable form. Assuming one can get usable data, the PMS must be capable of adeptly managing entry adds, changes, and deletes. Updates can be delicate processes (often “all or nothing”), which pose the risk of wreaking havoc on existing record references. The recently adopted NPI (national provider identifier) has helped to some extent, but many problems remain.
Providers, procedures, diagnoses, payers, locations and specialties are all just some of the many master files that need to be managed within clinical and practice management systems. The larger the practice, the more this becomes a critical focus and expense of the team managing these systems. Some can be standardized, but some will always be local, and the ability to customize and control these tables is a key vendor differentiator.

**Payment Posting and Contract Management**

Of course, most claims are not rejected. The next challenge for the PMS is payment posting. Here again, efficiency would demand electronic payment posting. Reality is far different. The details of payment posting vary considerably. Some providers use bank lockboxes and other services that simplify (or complicate) the process, but the basics are the same.

The payer sends a payment with an EOB (explanation of benefits), typically for many claims at once. The job of payment posting is interpreting the EOB and assigning the correct amount of money to each claim. In large practices with manual payment posting, this may take many full-time employees (FTEs). The procedure is also error prone, making this whole process a ripe target for automation. Barcoding, optical character recognition, and a variety of other technologies have been applied to try to clean up payment posting with varied degrees of success. Rich EDI is probably the most promising solution (short of adopting a single payer insurance plan).

Once posted, there are two more problems the PMS must contend with: overpayment and underpayment. Overpayment most commonly occurs when both the patient and the payer send the provider a payment. This requires a method for refunding which, in many practices, requires a link to a separate accounts payable system.

In today’s world of managed care conglomerates, underpayment is the more serious problem. Even within one company, claims may be processed by multiple systems that may not have the current contract and payment policies loaded. Therefore, inappropriate rejections and underpayments are common and often appear to be idiosyncratic. Further, in many states, there is little accountability by regulators. In a study performed at Weill Cornell and Emory, between three and eight percent of all reimbursements from managed care companies were underpaid compared to contract. While this represents tens of millions of dollars to providers, annually payers are only fined a small fraction of this amount by regulators, leaving enforcement of the contract up to the prowess of the provider’s management and information technology.11

Contract management systems, integrated or added on to the PMS are the provider’s defense against these errors. If the PMS knows how much the payer is supposed to reimburse for a given procedure, it can alert the provider to underpayments, individually or systematically. Underpayments of a few dollars are the most insidious, as the cost of reprocessing the claim will exceed the difference collected. This is why tracking underpayments over time is essential, so that underpayments can be addressed in bulk.

Full-featured practice management systems provide many more features and functions. Some provide scanning and document management capabilities. Some manage paper charts in ways analogous to a hospital health information management (HIM)
system. Many have sophisticated materials management capabilities, which are particularly important for specialties in which expensive medications or equipment are used.

One final critical feature to any PMS is reporting. The biggest payoff to any information system comes from the ability to extract and manipulate data that have been captured during the routine course of business. Cheaper systems come with pre-configured reports and few tools to manipulate them. More sophisticated systems provide myriad options for extracting data and configuring reports.

**CLINICAL SYSTEMS AND BIOMEDICAL DEVICES**

The distinction between clinical systems and biomedical devices is becoming both difficult to make and less important. Traditionally, the line between them was apparent. Devices were typically electro-mechanical, diagnostic and procedure oriented. From an IT perspective, they were data sources. Perhaps the most important distinction was that biomedical devices were regulated by the U.S. Food and Drug Administration (FDA). Any changes to their function required recertification. Conversely, information systems were electronic, transaction and documentation oriented, and unregulated in their plasticity.

While some of these distinctions still hold today, their importance is increasingly moot. Clinically, it is completely natural that the systems cardiologists or radiologists use to make a diagnosis should be fully integrated with the systems they use to report their findings. Similarly, from a patient’s perspective, the test report is no less part of their medical chart than the note of the physician who ordered the test or procedure.

It is not surprising, therefore, that the marketplaces for these once separate entities are now merging. The leading manufacturers of biomedical devices, such as GE and Siemens, are now also leading vendors of EHRs.

That said, this chapter will not examine further traditional, “know one when I see one,” biomedical devices, such as electrocardiography (ECG) and x-ray machines, regardless of how proximal they may have become to clinical systems. One reason for this is that they are still purchased and managed differently in most institutions. But more important, biomedical devices do not fit as cleanly into the major thesis of this section. That is, Clinical Systems are the essential workflow managers of ambulatory medicine—or, at least, they should be.

The reason to emphasize workflow is that it is the key to success for executives who need to purchase, implement, and manage these systems. A brief history of clinical systems shows that this was not always the case. In fact, many, if not most, clinical systems on the market today reveal a modular orientation that reflects how their development was funded, as much as any well-thought-out technical architecture.

**A Very Brief History of the AEHR**

The first attempts to build electronic medical records were largely in the outpatient arena. Barnett’s landmark work in the 1960s with COSTAR emphasized increasing the availability and organization of medical records. Separate modules for registration, scheduling and the actual clinical encounter form were implemented.

In the 1970s, McDonald at Regenstrief and Stead and Hammond at Duke also developed outpatient medical record systems. The Regenstrief system also used
encounter form data input similar to COSTAR but pioneered the emphasis on automated reminders. Stead and Hammond’s TMR system actually attempted to go paperless, using clerks to enter data.

Throughout the 1970s and 1980s, technology became more affordable and adequate to the task of building medical records. Computers moved from mainframes to minicomputers in the 1970s and from mini-computers to micro-computers in the 1980s. Recall that at this time, most medical centers were organized in a very decentralized manner. Outside the institutions, independent practitioners and small groups were still the norm. Therefore it is not surprising that the medical record systems that developed reflected this departmental and practice-oriented organization. In the 1990s, when graphical programming and database management tools became ubiquitous, these forces of “dis-integration” were even more profound. Commercial systems were specialty focused, procedure oriented, and doctor centric.

Large institutions were installing more centralized systems in hospitals but, even there, the industry was moving toward decentralized client-server designs. The sales teams advocated “best-of-breed”—as much a justification for the way things were as for any nobler architectural reason.

What resulted is the situation most institutions and practices are in right now. Every business unit or clinically distinct entity has (or wants) their own information system that meets their needs. There are significant merits to this approach. Many niche systems do, in fact, meet the workflow requirements of any given specialty far better than general purpose systems that are “customized” for their environment. The needs of a cardiology practice offering echocardiography and cardiac graphics are quite distinct from gastroenterologists offering in-office endoscopy, though both are subspecialties of Internal Medicine. Venture into radiation oncology, physiatry, ophthalmology or almost any other common outpatient medical specialty and you will find radically different functional requirements, workflows and expectations.

This challenge of sub-specialization exemplifies perhaps the most fundamental strategic IT choice facing an executive who manages clinical systems: the choice between an aggregation of interfaced best-of-breed systems versus a monolithic system. If each subspecialty can have a better system for themselves purchased separately, is the total greater or less than the sum of the parts? Does a unified platform offer economies of scale and degrees of interoperability not feasible with multiple interfaced systems?

This struggle is illustrated in the history of results reporting and order entry system discussed in the next section. Fifteen to 25 years ago, many order entry and results reporting systems were separate. Integration now allows “loop closure”; an order is closed when the result comes back. But in ambulatory practices that order from many labs that combine systems, that integration is more complex and costly and might lock you into one laboratory provider.

**Order Entry and Results Reporting**
The earliest and most basic clinical systems were result reporting systems that allowed viewing of the output of laboratory and other biomedical devices. Lab data are typically numeric and relatively easy to categorize and display. Textual results, such as pathology and radiology results, were also fairly analogous to other data routinely managed
by early business computers. Graphical results and images arrived later with the more powerful hardware and software required to support these modalities.

Typically absent from simple result reporting systems is any facility for data entry. The user interface characteristics required for data entry and data display are radically different, the former being far more challenging. Early monolithic systems had a relatively modest goal of unifying all the entered data into a single repository, while specialized data entry systems were permitted in departmental silos. The user interface characteristics required for data entry and data display are radically different, the former being far more challenging. Early monolithic systems had a relatively modest goal of unifying all the entered data into a single repository, while specialized data entry systems were permitted in departmental silos.15

More recently, due to the economic power of the physician's pen, many hospitals have focused on order entry systems as the centerpiece of their clinical systems efforts.16,17 In the ambulatory world, order entry can be a small or insignificant component of the workflow in some specialties. Further, the economic imperatives are very different in the outpatient world (especially with fee-for-service), and the ROI from an order entry system may be harder to realize than at a hospital (with prospective payment). That said, ambulatory order entry is still a big business. Many laboratories will give physicians a results reporting system if they will use their online order entry system. The laboratory gains efficiencies, but they still have to give the physician an incentive to use a potentially less convenient system than paper. In large institutions and practices, order entry systems can be very helpful in controlling the flow of referrals. Order entry systems are all but essential in ambulatory practices under capitation in order to control utilization.

Evidence suggests that ambulatory CPOE can be time neutral to physicians, but not all order entry systems are created equal.18 The minimal systems, some of which are now free, just write prescriptions. For specialists that prescribe a lot of medications, comprehensive support for refills, including aging and reminders, can be a major time-saver and are frequently the first clinical systems installed. Prescriptions are different from inpatient orders in several respects. The ability to print prescriptions in locally mandated formats is not to be assumed. Inpatient systems also generally have limited formularies, whereas outpatient systems generally need all available drugs. Worse still, in managed care environments, ambulatory systems often have to maintain multiple formularies and distinguish between drugs that are on and off plan. Medicare Part D has made this function almost essential, and yet support within EHRs remains awkward at best.

Inpatient systems tend to be more focused on drips and compound preparations. These exist in the outpatient world as well such as in oncology infusion centers. Such sites need the full medication administration record (MAR) functionality common to inpatient systems. But they are certainly less common and typically less complex than in the inpatient setting. Conversely, ambulatory centers that do dispense drugs often do so without a pharmacist as intermediary. This means that the system must support the functions pharmacists provide. For example, when a sample is given, the system must produce a label with instructions for the patient and log the lot number of the drugs dispensed.

E-prescribing, the transmission of prescriptions electronically, has been rapidly expanding due to recent incentives from the federal government and certain payers. As of this writing, such systems still have a lot of rough edges. The standards were pushed through without fully bi-directional communication, which requires reconciliation of
currently incompatible drug vocabularies between pharmacy and physician systems. Therefore acknowledgement, cancellations and some safety features are lacking. Some pharmacies still cannot accept electronic prescriptions, so some systems resort to faxing behind the scenes, which is fraught with security and privacy problems. Still, this is clearly the way most prescriptions will soon be written, and executives would be remiss in not planning for this capability.

Similarly, prescription fill information is becoming available electronically from payers. The availability of this information has the potential to alter physicians’ ability to monitor patient compliance. Because ambulatory patients administer their own individual doses and may not submit claims for every prescription filled, the reconciliation of fill data with the original prescription is still imperfect. The potential of this capability to improve care is large, but too little has been done to contemplate the workflow impact these data will have on routine visits. Physicians may object to another uncompensated demand on their time.

For laboratory orders, key features in an ambulatory environment again differ from the inpatient world. Most hospitals send all their lab specimens to one laboratory. In the outpatient world, this may be desirable, but managed care contracts often mandate the use of a particular lab. The ability to control default routing rules based on contracts is a vital revenue control point for sites that maintain their own laboratory.

True integration with multiple laboratories is technically very challenging, but it is also very desirable for many reasons. If the outbound order and the incoming result are linked (loop closure), then there is more potential for sophisticated features, such as alerts and reports. For example, a common cause of malpractice claims is the failure to note an abnormal Pap result. Systems with loop closure can alert a physician both to the arrival of an abnormal result and the failure of any result to return after a specified time, thereby diminishing the risk of lost data.

The most difficult aspect of linking to multiple labs is reconciling the coding systems for the orders and the results. As of this writing, there is no satisfactory coding system for either orders or results, and those that do exist are poorly cross-mapped. CPT® is often used when placing orders, but it is too imprecise and incomplete to be used exclusively. Similarly, Logical Observation Identifiers Names and Codes (LOINC®) is emerging as a standard for coding results, but it is also very incomplete and idiosyncratically applied. Certain areas, such as microbiology and transfusion medicine, remain particularly problematic. The National Library of Medicine funded an effort to map CPT and LOINC.10 While this helped, the fact remains that operations managers faced with multiple laboratories need to commit considerable resources to map procedures and result components. Failure to accurately map the clinical tests can severely compromise the usability of the EHR.

The ability to configure order sets in ambulatory systems is not dissimilar to inpatient order entry systems. Likewise, clinical decision support rules have similar value in both settings. In the outpatient world, there is the additional uncertainty of knowing all medications a patient is taking. This is a topic of considerable conflict in organizations with shared charts. Some specialists object to seeing the full list of medications in their chart, fearing responsibility for drugs they do not prescribe. Of course, this is an issue of
legal liability, not medical care. But it can require system managers to jump configuration hurdles before specialists will buy into a common EHR.

In 2005, the Joint Commission made “medication reconciliation” one of its national patient safety goals. They require that at transitions of care, providers exchange a complete list of the patient’s medications. They explicitly include discharge to ambulatory settings. A shared EHR should make this process easier, if not automatic, with the record itself. But the pass-off between EHRs will require a substantial improvement in state of the art interfacing technologies. While technically feasible, today, few systems support this kind of automated reconciliation. The Joint Commission based its recommendation on staffing and process models from the inpatient world, and implementing their ideas outside of hospitals has proven difficult.

Analogous to diagnosis-related group (DRG) reimbursement in inpatient settings, one of the more complex features in ambulatory order entry is “medical necessity” checking. The quotation marks here are to emphasize that the definition of medical necessity is an insurance construct, not a clinical assessment per se. The primary impetus for this requirement comes from Medicare. Through a process called National and Local Coverage Determinations (NCD/LCD – previously called Local Medical Review Policies [LMRP]), Medicare will only reimburse for tests that it deems medically necessary. Since these rules frequently do not meet the needs of individual patients, physicians need to be alerted when they are ordering a test that is not covered. For example, a patient with cancer might need heart tests prior to taking a cardiotoxic drug. It would be clinical malpractice not to perform the test, but it may still not be considered “medically necessary” financially.

There are two major reasons to generate NCD/LCD alerts. The first is the intended effect of the regulation: to draw attention to the physician that the test or drug may not be clinically indicated and an alternative should be sought. The second reason is to alert both patient and provider that charges will go unpaid by the carrier. For providers, particularly laboratory and radiology facilities, this can be a key source of uncollected debt. The ordering provider should give the patient an ABN (advance beneficiary notice), which alerts patients how much they are likely to be charged for what the payer may deem unnecessary.

The process for documenting medical necessity is fairly crude. The diagnostic code (typically International Classification of Diseases [ICD-9]) the physician associates with the order (typically coded by CPT®) either matches an approved list designed by the NCD/LCD or it does not. Practices that are very focused on downstream revenue may seek even more sophisticated alerts to question providers who order tests with codes that they may incorrectly be using as “rule outs” rather than using symptom codes. This is presently at the boundary of commercial system functionality.

The last major category of order entry functionality is referrals. These are similar to inpatient consult orders but are a great deal more complex due to third-party reimbursement rules and geographic variation inherent to outpatient care. In many managed care plans, the ordering provider is supposed to solicit an eligibility and pre-approval code before sending a patient to another specialist. Some systems automate this process to some extent, but the rules and documentation requirements are quite variable, making full automation very difficult. If providers find themselves or their staff spending hours soliciting these approvals, executives would be wise to spend as
much time renegotiating contracts to simplify and standardize these procedures as they might trying to get the IT staff to automate a chaotic process.

In an ideal patient experience, the referrals can be linked to the scheduling process. This is quite plausible if the order entry system is integrated with the scheduling system and the payer rules allow for such simplification. In reality this kind of service is most likely to be found only in highly integrated care delivery systems, regardless of their IT infrastructure.

**DOCUMENTATION**

While results reporting and order entry remain the core of many EHRs, the key to the ambulatory medical record is documentation—particularly physician documentation. This is also the most technically difficult challenge for any medical record system for several reasons. The major challenges in medical informatics generally come together in physician documentation. User interface design, workflow management, structured vocabulary, database performance and hardware limitations are all major limiting factors to what we can practically deliver to support the most elemental component of medical care: the doctor-patient interaction.

As with results reporting and order entry efforts already discussed, the first efforts to automate physician documentation were modular. Specific attempts to capture a progress note, a procedure note, a Simple Object Access Protocol (SOAP) note, or a flow sheet have had varying degrees of success. The simplicity of scribbling pen on paper exceeds any EHR, though an EHR can provide legibility, practice standardization, ubiquitous access and clinical decision support.

There is a profound and complex number of nuanced features that need to be added together to build a fully functioning ambulatory documentation system. Not all of these features are needed for every practice or every specialty. Nevertheless, they may be essential to even a single physician in a group, so failure to accommodate the requirement may eliminate the ability to automate that physician in the EHR. This is a key point that is lost on many IT managers and is worth exploring.

There is a difference between essential and non-essential customization. Detailing the many essential and optional functionality offerings in ambulatory systems is beyond the scope of this chapter. More comprehensive lists are readily available elsewhere. Some of the features that illustrate the difference between critical and extraneous customization vary by specialty or setting.

Drawing is a basic element of some physician documentation, such as ophthalmology, that is completely absent in some specialties. Similarly, photography is essential in plastic surgery but optional in most general internal medicine practices. Flow sheets are the primary method of documenting in some specialties, particularly those with repeated visits over a finite period of time, such as obstetrics or in practices focused on a particular disease or procedure, such as diabetes or dialysis. Many “disease management” systems focus on this kind of documentation. Some practices have extensive forms completion requirements, such as general pediatrics or practices with heavy managed care oversight, such as cognitive psychology. Similarly, specialists who perform procedures have very different documentation requirements than those doing evaluation and management. In academia, the ability to extract data generated at the point of care into
research databases is critical to the research mission over and above immediate clinical needs. Consultation-heavy practices require robust correspondence support. Any practice with a wide referral base outside the EHR user base will require a scanning system to handle paper brought into the office, while practices that are completely self-contained will have little need for this feature. Practices using physician extenders or supervising residents and students will have complex co-signature requirements.

These kinds of features differentiate systems that can succeed in particular practices and specialties from those that might actually harm productivity by forcing the implementation of a parallel system that works around the oversights. The challenge for the executive is to differentiate these essential business functions from optional features that may slow down implementation and run up costs.

The key to understanding which features provide value and which do not is to examine workflow. This is where systems that deliver functionality in modules reach their limits. All the features in the world can be present in a system, but if they do not hang together for the users in a manner that flows logically within real world use, then the system may cause more harm than good. The National Institute for Standards and Testing (NIST) and CCHIT have published certification requirements that detail the functionality an AEHR should achieve. But these requirements say nothing about how the functions work together to achieve a manageable workflow. The Apple Newton introduced amazing new functionality but was practically unusable, so it failed in the marketplace. The unwritten requirement is that all these functions work for the physician without slowing him/her down or compromising his/her sanity.

EHR enthusiasts try to sell these inherently inefficient modular systems by emphasizing the myriad benefits that occur downstream once the initial penalty is paid. These downstream benefits are real and profound. They start with simple legibility, simplified filing and access and the ability to use one data entry point for multiple purposes, such as a progress note and a consultation letter.

These benefits are the essential foundation upon which most present office automation efforts are currently justified. But executives looking for ambulatory solutions today need not stop there. The greatest potential of these systems comes when they can predict where the user will go next and lead the provider through the visit. This is exactly the opposite of a modular system in which the provider may have to disrupt the workflow to search for different functions.

This is beyond the current state of the art in commercial clinical systems. Still, it is where today’s executive should be looking when deciding what is needed. Workflow analysis quickly leads to the recognition that system integration is required to make sure data flow in a coordinated manner.

Through the examination of workflow, four additional key functions of clinical systems that go beyond any individual “module” are revealed as essential to the system architecture: messaging, interfaces, decision support and patient data entry.

**Messaging**

Messaging could, perhaps, be viewed as a module itself. Indeed, if a practice had limited funding, the cheapest and easiest system to implement to increase efficiency would be an instant messaging system. But within a full-featured EHR, clinical messaging can
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become the central task management tool of a practice. The key difference is the ability to route a message within the context of a patient’s chart. This context extends the physician’s capacity to utilize support staff, freeing the physician for more productive work. Leading products categorize messages into multiple queues such as new results, orders awaiting co-signature, messages from colleagues and even personal notes about tee times. Messages can go to multiple staff at once to work down a queue and can be rerouted during vacations or for on-call coverage.

Some systems clearly separate messaging from task management. In larger practices, this is probably wise. As the physician workflow progresses along the patient encounter, a variety of tasks queue for the ancillary staff, such as rooming and taking vitals, drawing blood, and processing referrals. How elegantly these processes are integrated with the system will dictate the success of managing the entire practice workflow rather than just isolated pieces of it.

Secure messaging is generally inherent within a given EHR. Communicating between EHRs and over the Internet generally requires different technology, lacking from most existing systems. Communicating with patients through a secure portal is clearly preferred over e-mail and is becoming a standard among top-tier practices.

Interfaces
Interfaces are the glue between modules of non-integrated systems and the mechanism for sharing data across entirely dissimilar systems. The richness and complexity of interfaces is more than enough of a topic for a whole book in itself. The key points executives need to understand about interfaces in ambulatory systems relate to what interfaces can and cannot accomplish and what buzzwords to look out for.

A purely stand-alone system requires no interfaces. Such systems are not uncommon in a small ambulatory setting, though they are quite limited in functionality. We have already reviewed the key administrative interfaces required for practice management. Electronic linkages to insurance companies are mandated by HIPAA (Health Insurance and Portability and Accountability Act of 1996), and federal “meaningful use” guidelines require some interoperability, so the era of stand-alone systems is clearly coming to a close.

Early efforts at interfaces were so-called point-to-point custom interfaces that required coding far too extensive for all but the largest ambulatory providers. In 1979 the American National Standards Institute (ANSI) chartered the Accredited Standards Committee (ASC) X12 “to develop uniform standards for inter-industry electronic interchange of business transactions—electronic data interface (EDI).” In the past 30 years, that body has developed more than 300 business-to-business transaction sets.27

In the late 1980s, healthcare joined the EDI standardization process with the creation of HL7 (Health Level 7), a set of semantic standards for exchanging data between healthcare information systems. HL7 was accredited by ANSI in 1994.28 These standards define many of the key transactions that are necessary to implement clinical and practice management systems. Besides the basic insurance transactions, ambulatory systems generally rely on ADT/Registration and scheduling interfaces, as well as clinical integration with laboratories, radiology systems, transcription providers and pharmacy systems. Other common interfaces include a wide variety of diagnostic devices
such as endoscopes, spirometers, EKG systems and similar equipment associated with individual specialties.

Anyone attending to practice workflow quickly realizes that more and better interfaces are critical to physician efficiency.\textsuperscript{29} And just as quickly, the deficiencies of current interface standards are revealed. The problems are not dissimilar from those faced in inpatient settings, but the emphasis is typically different.

The first problem is the need for multiple interfaces itself. Interfaces are rarely “plug and play” and even once implemented, they generate error queues and exceptions that require policies, procedures and staff resources to handle. In a large healthcare system, an interface group may be dedicated to these issues. In a small ambulatory practice, this is often impossible and the errors either will go uncorrected or the interface is eliminated.

Ambulatory practices within larger institutions face a related problem of scale. While large IT shops may have the staff to handle implementation and error queues, the priorities of integrating a single obscure medical device may be quite low compared to a new laboratory feed for the whole hospital. But without that device, the single physician or practice cannot do his/her job. For example, it may be easier for a whole hospital to do without an interface to a spirometer than for an allergist or pulmonologist in their private office.

The problem rests in the interfaces themselves. As mentioned earlier, HL7 is primarily a \textit{semantic} standard. It dictates what the message means, not how it is said. There are two problems left unsolved. First, the semantic standards are quite limited. HL7 covers the basics only, and even there enormous flexibility remains such that two vendor systems can both be “compliant” and not be able to understand one another. Second, HL7 does not standardize how messages are sent. This is called \textit{syntax}. HL7 has integrated a widespread syntactic standard called XML into its new standards, which should help ease this problem, though adoption is far from complete.\textsuperscript{30}

Presently a debate is raging about the best way to combine semantic and syntactic standards. This has tremendous relevance to executives interested in ambulatory systems. The key argument is between advocates of comprehensive detail versus ubiquitous simplicity. It is not completely unfair to characterize this as a battle between the haves and the have-nots.

Those who have wide-ranging systems with rich feature sets need comprehensive standards to move data between systems. Some of the features laypeople desire or even expect from clinical systems require extremely advanced interfacing techniques. Consider the perfectly reasonable expectation that a patient’s laboratory results or medication list should be able to move from physician to physician. To do this without any loss of information would require that we agree to use far more sophisticated semantic standards that include vocabularies for lab tests and medications. As mentioned earlier, vocabularies like LOINC and the RxNorm system are not comprehensive or adaptable enough for use in all settings, so even if they were widely adopted, local customizations would be the norm, adding even more complexity to the interfaces.\textsuperscript{31}

Those who have fewer resources, or are just trying to get into the game, are willing to settle for far simpler standards. In 2006 a competing standards-making body proposed a much simpler standard than HL7—\textit{ASTM CCR}\textsuperscript{32} (continuity of care record)—which
was embraced by the American Academy of Family Physicians (AAFP). The CCR takes a “snapshot” of patients at transitions of care in an XML document standard. Semantic details are optional, allowing for the basic transmission of information which advocates call “good enough” and critics view as the lowest common denominator. AAFP’s first criterion for EHR-related activities is affordability. They are also articulate in advocating plug-and-play compatibility and avoiding “vendor lock.” This is largely in reaction to what many perceive as the opposite tendency in HL7. Ironically, while some consider HL7’s complexity specifically designed to serve vendor interests, many vendors themselves set up their own advocacy group separate of HL7 in 2004, the HIMSS Electronic Health Record Vendor Association (EHRVA) with promotion of “extensibility to other document types and discrete data” as an explicit goal.

Some reconciliation of these standards has occurred. But the arguments behind this debate are inherent to any standards-making discussion. Standards enable some functions at the expense of flexibility to do other things. Understanding the motives of various vendors who support different standards in different ways is important to determine if they will meet your needs in the long run.

Another HL7 standard, called CCOW (Clinical Context Object Workgroup), shows promise for ambulatory centers in that it can help avoid other costly interfaces altogether. CCOW is a standard for flipping between different applications without requiring a new log on and even carrying the existing patient context. Therefore, a user can move from a laboratory results reporting system to a documentation or order entry system with a few clicks. The actual data stay in each system and cannot flow between them without building specific interfaces. But for sites that lack the resources to deal with all the complexity just described, CCOW may offer enough of the illusion of integration that physicians can still get their work done.

**Decision Support**

Most modern clinical systems have some form of a rules and alerts engine to improve quality, revenue and compliance. The extent to which data flow across modules dictates the sophistication possible in the delivery of alerts. The simplest systems are passive and post-hoc. They take data already created and analyze them in batch form, generating reports or messages to be responded to after the fact. Such systems remain important today, as we will always want to look backwards or across encounters for diverse reasons, such as drug recalls or auditing.

Modern systems also allow for real-time alerts that can actively modify how care is delivered. A modest amount of research has demonstrated or suggested the efficacy of computerized alerts in improving a variety of quality measures such as vaccination and screening tests, reducing over-utilization and avoiding adverse events. Serious issues remain to be resolved that executives need to understand as this technology is pursued in the future. For example, overwhelming physicians with too many alerts can be counterproductive. Too little research has been done on the relevancy of alerts in subspecialties and in patients with complex comorbidities. The maintenance of the knowledge base that drives complex alerts is costly and potentially dangerous if not done correctly.
Ambulatory systems managers may consider starting with whatever alerts can be purchased in a subscription form, so that the knowledge base is easy to maintain. Drug interactions, medical necessity rules, and formulary lists are some examples of commercially available rule sets. Even some of these will require configuration resources to work optimally. For example, drug-disease interactions will require that problems and lab results are coded in a particular way that the rules engine can detect.

Another area to investigate is pay-for-performance guidelines to which providers are subject in your practice. Another chapter in this book expands on quality issues in greater detail. A few points regarding ambulatory systems are worth reiterating here. First, payers are evaluating performance primarily based on claims data. These data are fraught with peril.

In two samples at our institution, data from the payers were found to be incorrect for more than 90 percent of the patients. Since payers are cutting reimbursements and ranking physicians based on these data, the ability to analyze your actual performance may become critical to maintaining revenue. Such analyses can be quite difficult unless you have highly structured data and excellent documentation compliance from your providers.

Consider the following typical ambulatory quality metrics:
1. Percentage of patients with congestive heart failure currently taking an angiotensin-converting enzyme inhibitor (ACEI) or angiotensin-receptor blocker (ARB).
2. Percentage of diabetic patients with a glycohemoglobin measurement within the past 6 months.
3. Percentage of hypertensive patients with an ophthalmology exam within the past year.
4. Patients older than age 65 years with pneumococcal vaccination.

Performance on all four metrics could be improved with an alert to the provider at the point of care. Further, it is likely that, at some point, a patient could trigger all four alerts, therefore making it easier for the provider to comply than to ignore the alert. This presents the system manager with several technical challenges. First, all the diagnoses need to be coded with sufficient specificity that the correct patients are identified. Second, the laboratory, medication, vaccination and ordering data need to available in a form that includes and excludes the correct patients. Do you want providers to have to slow down and explain to the computer why a particular patient with a particular potassium or renal condition should not get an ARB? If the insurance company is going to make the physician say so, then it is probably worth the effort. If not, it is probably worth coding this out of the alert. Does your system capture enough data from events outside your practice to reliably know if a patient did or did not see the ophthalmologist?

In many instances, payers have access to a broader set of data than the physician caring for the patient. Also payers may be missing data that doctors would like to know is missing—such as the failure to fill the prescription for the ARB or breaking the ophthalmology appointment.

At this time, few systems can respond to all the issues raised by pay-for-performance and quality management initiatives. However, much of the mandated reporting to date has been just to report the performance data, even when they are
poor. So, once again, the best the executive can do is learn about the technical issues involved and plan for the optimal combination of solutions for your practice.

**Patient Data Entry**
The final workflow-optimizing technology to discuss is patient data entry (PDE). Here again, separate modules may exist to give patients questionnaires, allow them to sign consents and authorizations online, or even conduct clinical interviews. Once this technology is integrated into the full EHR, the power to radically alter physician workflow becomes apparent.

If patients can record their complaints; family, social, and past medical history; and review systems online prior to meeting with the physician, several positive consequences will result. Computerized interviews provide more data, allow for asking more sensitive questions, give patients more time; can be adapted for language, hearing impairments, and education level; and when fed into the EHR, they can lower the amount of time physicians spend documenting.\(^{43}\) Further, by obtaining structured data before the patient is seen, these systems provide clues the computer needs to present physicians with the most appropriate content and structure for their own workflow.

Although these systems are still at the cutting edge of clinical computing today, the very first computer applications for medicine—a half century ago—were patient interviewing tools.\(^ {44,45} \) Clearly the goals of those systems remain compelling today. With the adoption of patient portals rapidly accelerating, these kinds of techniques should become easier. Managers still need to decide individually when the technology will be mature enough to add value ready for their practice.

**Infrastructure.** The infrastructure issues for ambulatory systems are also similar to inpatient systems but different in emphasis. The scale of ambulatory systems varies from single physician offices to large multi-state groups with thousands of providers. Obviously very different technologies are needed to serve these different constituencies.

Regardless of size, one of the most fundamental questions that needs to be answered early is the degree to which integration is desired in technology and content. Some vendors provide a centralized platform from which huge numbers of users can share a common chart over large geographical distances. Others distribute the systems, often replicating the chart in multiple locations when content needs to be shared. Smart, well-intentioned people can argue the pros and cons of this and a thousand other architectural differences. The key to getting the right solution for your organization is, once again, workflow.

If you know how your organization works (or should work), you can find the right system. If you share a medical record number across disparate sites, chances are you need some kind of centralized system for keeping them in sync. If not, then you do not need to solve this problem, unless you want to share other data. If you have a lot of remote rural sites with variable networking infrastructures, then a system that relies on high bandwidth connectivity is off the table. Conversely, if you are in an urban environment with immense radio interference issues, a system that relies on a crowded wireless network band may not be advisable. If workstation management presents challenges, then a thin-client architecture may be appealing. In settings without the necessary IT staff, this may add complexity rather than reduce it.
Supportability and reliability are other key issues that differ in the ambulatory world. Consider the impact of the loss of a single computer to a busy outpatient center without technical support for 24 or 48 hours. Is that acceptable? Can you afford a shorter time frame? Downtime happens, by accident or design. Does your system provide you with the back-up tools to get by for an hour, a day, a week?

Conversely, diffuse geography may put you at the mercy of an unreliable Internet provider, SaaS, or ASP. In that case your workflow may be forced to accommodate the idiosyncratic infrastructure rather than vice versa.

Interoperability with inpatient records varies in importance by practice and specialty. Security and privacy issues similarly may differ according to the interoperability of the workflow both locally (e.g., nurse and doctor charting on the same patient in the same room) and regionally (e.g., subspecialty referrals across a multi-entity organization).

Earlier, the monolithic versus best-of-breed decision was referenced, as well as repository-based architectures. A related dimension to consider is the segregation of transactional and reporting systems. The system that supports day-to-day operations needs to be oriented toward high speed, single patient transactions. Reporting systems generally look across patients and do not require sub-second response times. Therefore, these jobs are often separated into separate systems.

A detailed discussion of infrastructure is beyond the scope of this chapter. One rule of thumb to keep in mind is that while it may seem expensive, infrastructure is rarely a good place to skimp. Hardware is often the cheapest way to hide the inadequacies of software. But this is only true if you focus on the real bottlenecks as opposed to technical fashion or fads. When selecting infrastructure components, plan for the future but be realistic about the pace of institutional change. Otherwise you risk wasting money on capacity you will not use before it is obsolete.

**COSTS AND RETURN ON INVESTMENT AND “MEANINGFUL USE”**

Most physician practices now have some form of information technology, but relatively few have a full EHR. Not surprisingly, practice management systems have far greater market penetration than purely clinical systems. As discussed earlier, PMSs provide a direct impact on revenue and cost control. The value of purely clinical ambulatory systems is often more abstract or delayed. Chismar and Thomas have presented an economic model of EHR adoption that illustrates how larger entities, like payers and hospitals, gain more quickly from EHRs than do small providers. Scrutiny of other models that show benefit from EHRs also reveal that the system benefits are greater than those to the individual physician. That doesn’t mean the value is not present, but given the large start-up costs, physicians are poorly incented to adopt systems that benefit others more than themselves—especially if system adoption costs them more than the prime beneficiaries.

At a very high level, the value of the EHR to society is potentially huge. Enhanced quality, better outcomes, an improved patient experience and lower total costs are all great. But should the individual physician or practice foot the bill? There are plenty of
Interest in the adoption and use of EHRs has been greatly enhanced by virtue of recent legislation. As part of the American Recovery and Reinvestment Act of 2009 (ARRA), the Obama administration introduced the Health Information Technology for Economic and Clinical Health Act (HITECH). HITECH designated billions of federal dollars to incentivize the adoption of health IT via grants for education projects that integrated EHR technology into the clinical education of health professionals, funding for strategic health IT projects and bonus payments for providers and hospitals to adopt certified health IT.

In order to promote the adoption of the EHR, the federal government designed a Centers for Medicare & Medicaid Services (CMS) bonus payment program (via Medicare and Medicaid) for both eligible providers and hospitals. The program is designed to make incentives available for five years, with early qualification leading to maximum potential monetary bonus. After 2015, the program will transition to penalties via withholding of escalating percentages of Medicare/Medicaid reimbursement. The EHR incentive program mandates that hospitals and providers use certified EHR technologies in order to qualify for bonuses. EHR certification standards and bodies, described in detail elsewhere in this book, continue to evolve via ongoing national committee work and legislation.

In addition to installing a certified EHR system, providers and hospitals must demonstrate that they are using the technology in a meaningful fashion. The now ubiquitous term “Meaningful Use” refers to this set of important behaviors. Conceptually, the Meaning-
ful Use objectives are those behaviors or functions that promote a core set of health outcome priorities delineated by the federal government. Those key priorities include:

- Improve quality, safety, efficiency and reduce health disparities
- Engage patients and families
- Improve care coordination
- Improve populations and public health
- Ensure adequate privacy and security protections for personal health information

The detailed mechanics of the incentive programs are subject to change and are beyond the scope of this summary. In general terms, the HITECH Act mandated that the Meaningful Use objectives would be defined in stages, with escalating sophistication of objectives and behavioral thresholds. The Stage 1 Meaningful Use criteria assume the capture of clinical information in coded format, use of coded information to track key clinical conditions and coordinate care, implementation of basic clinical decision support tools, and the ability to report clinical quality measures and public health information.

In July 2010, CMS published a final legislative rule that incorporated the comments and feedback of industry experts and stakeholders. This rule defines, in detail, the Stage 1 Meaningful Use requirements. The Stage 1 requirements are nicely summarized by Blumenthal and Tavenner in an editorial published in *The New England Journal of Medicine* that coincided with the publication of the final rule (see summary in Table 6-1). This legislative rule defines fifteen mandatory core objectives and their associated measures. Of the remaining ten “menu” objectives, a provider or hospital can choose to implement a minimum of five and still achieve Stage 1 Meaningful Use.

Stage 2 and 3 Meaningful Use criteria will be defined in future legislation. It is also likely that the mechanics of the incentive program and the EHR-certification process and standards will continue to evolve. Though the logistics will continue to be refined, the EHR incentive program is likely to have a profound effect on the pace and breadth of national EHR system adoption and feature development.

Money is only one barrier in a properly considered ROI equation. It remains to be seen if the incentives and penalties will be sufficient to overcome other barriers. Physicians also care about quality, time, convenience, regulatory compliance and a host of other issues that must all be taken into account to truly calculate ROI. This is, of course, not feasible and the inadequacy of the literature to date reflects that fact.

For example, some studies show ROI by reducing duplicate orders. Under capitation that is valid but under fee for service, one’s revenue might fall. At our center, we recovered millions of dollars of revenue that was going to outside providers that our EHR very gently pointed back inside. The cost was borne by our doctors and the benefit accrued by our hospital. From a business perspective, this is a big win for the medical center, but it will not show up in academic studies of ROI. From society’s perspective, this was just a cost shift and not a real reduction in the total cost of healthcare.

Other studies have shown return from up-coding, and the converse is also touted as a benefit by improving regulatory compliance. Other financial benefits include reduced transcription costs, reduced chart pulls, decreased charge-posting costs, pay-for-performance and various other efficiencies.
## Table 6-1: Summary of Stage 1 Meaningful Use Requirements

<table>
<thead>
<tr>
<th>Core Set</th>
<th>Measure</th>
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</thead>
<tbody>
<tr>
<td>Objectives to be achieved by all eligible professionals, hospitals and critical access hospitals in order to qualify for incentive payments</td>
<td>More than 50% of patients’ demographic data recorded as structured data</td>
</tr>
<tr>
<td>Record demographics: preferred language, gender, race, ethnicity, date of birth, and date and preliminary cause of death in the event of mortality in the eligible hospital or CAH</td>
<td>More than 50% of patients age 2 or older have height, weight, and blood pressure recorded as structured data</td>
</tr>
<tr>
<td>Record and chart vital signs: height, weight, blood pressure, BMI, growth charts for children 2-20 years</td>
<td>More than 50% of requesting patients receive electronic copy of health information within 3 business days</td>
</tr>
<tr>
<td>Provide patients with an electronic copy of their health information (including diagnostic test results, problem list, medication lists, medication allergies, discharge summary, procedures), upon request</td>
<td>More than 80% of patients have at least one entry recorded as structured data</td>
</tr>
<tr>
<td>Maintain up-to-date problem list of current and active diagnoses</td>
<td>More than 80% of patients have at least one entry recorded as structured data</td>
</tr>
<tr>
<td>Maintain active medication list</td>
<td>More than 80% of patients have at least one entry recorded as structured data</td>
</tr>
<tr>
<td>Maintain active medication allergy list</td>
<td>More than 80% of patients have at least one entry recorded as structured data</td>
</tr>
<tr>
<td>Record smoking status for patients 13 years old or older</td>
<td>More than 50% of patients 13 years old or older have smoking status recorded as structured data</td>
</tr>
<tr>
<td>EPs Provide clinical summaries for each office visit; Hospitals provide electronic copy of hospital discharge instructions upon request</td>
<td>Clinical summaries provided to patients for more than 50% of all office visits within 3 business days; more than 50% of all patients who are discharged from an eligible hospital or CAH who request an electronic copy of discharge instructions are provided it</td>
</tr>
<tr>
<td>Implement drug-drug and drug-allergy interaction checks</td>
<td>Functionality is enabled for these checks for the entire reporting period</td>
</tr>
<tr>
<td>Implement capability to electronically exchange key clinical information among providers and patient-authorized entities</td>
<td>Perform at least one test of EHR’s capacity to electronically exchange information</td>
</tr>
<tr>
<td>Implement one clinical decision support rule and ability to track compliance with the rule</td>
<td>One clinical decision support rule implemented</td>
</tr>
<tr>
<td>EPs Generate and transmit permissible prescriptions electronically</td>
<td>More than 40% are transmitted electronically using certified HER technology</td>
</tr>
<tr>
<td>Use computerized practitioner order entry (CPOE) for medication orders</td>
<td>More than 30% of patients with at least one medication in their medication list have at least one medication entered using CPOE</td>
</tr>
<tr>
<td>Implement systems to protect privacy and security of patient data in the EHR</td>
<td>Conduct or review a security risk analysis; implement security updates as necessary, and correct identified security deficiencies</td>
</tr>
<tr>
<td>Report clinical quality measures to CMS or States</td>
<td>For 2011, provide aggregate numerator, denominator, and exclusions through attestation; For 2012, electronically submit measures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Menu Set</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligible professionals, hospitals and CAHs may select any five choices from the menu list</td>
<td>Generate at least one listing of patients with a specific condition</td>
</tr>
<tr>
<td>Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research or outreach</td>
<td>Implement drug formulary checks</td>
</tr>
<tr>
<td>The EP/eligible hospital/CAH has enabled this functionality and has access to at least one internal or external drug formulary for the entire EHR reporting period</td>
<td>Incorporate clinical lab-test results into certified EHR technology as structured data</td>
</tr>
<tr>
<td>More than 40% of all clinical lab test whose results are positive/negative or numerical format are incorporated in certified EHR technology as structured data</td>
<td>Use certified EHR technology to identify patient-specific education resources and provide those resources to the patient, if appropriate</td>
</tr>
<tr>
<td>More than 10% of patients are provided patient-specific education resources</td>
<td>Provide summary of care record for patients referred or transitioned to another provider or setting</td>
</tr>
<tr>
<td>Summary of care record is provided for more than 50% of patient referrals or transitions</td>
<td>Submit electronic immunization data to immunization registries or immunization information systems</td>
</tr>
<tr>
<td>Perform at least one test of electronic data submission and follow-up submission, for registries that can accept electronic submissions</td>
<td>Submit electronic syndromic surveillance data to public health agencies</td>
</tr>
<tr>
<td>Perform at least one test of electronic data submission and follow-up submission, for public health agencies that can accept electronic submissions</td>
<td>Perform medication reconciliation between care settings</td>
</tr>
<tr>
<td>Medication reconciliation is performed for more than 50% of patient transitions or referrals</td>
<td>Additional Choices for Hospitals and CAHs</td>
</tr>
<tr>
<td>Record advance directives for patients 65 years and older</td>
<td>More than 50% of patients 65 years and older have an indication of an advance directive status recorded</td>
</tr>
<tr>
<td>Submit electronic data on reportable laboratory results to public health agencies</td>
<td>Submit electronic data submission and follow-up submission, for public health agencies that can accept electronic submissions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Choices for EPs</th>
<th>Measure</th>
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</thead>
<tbody>
<tr>
<td>Send reminders to patients (per patient preference) for preventive and follow-up care</td>
<td>More than 20% of patients 65 years old or 5 years or younger are sent to appropriate reminders</td>
</tr>
<tr>
<td>More than 10% of patients are provided electronic access to information within 4 days of its being updated in the EHR</td>
<td>Provide patients with timely electronic access to their health information; this includes lab results, problem list, medication lists, medication allergies</td>
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</table>

Critics of these studies abound. Costs of implementation are difficult to accurately account for. Once live, there are hidden costs rarely accounted for in any analysis. Dealing with temporary employees is far more complex in an automated environment in which training is more complex and less intuitive than in the paper world. Conversely, benefits such as integrated access to reference materials or sophisticated reporting capabilities are extremely difficult to assign value to in a finite period of time. Even the cost of the software itself is hard to standardize and is almost always overemphasized as a cost relative to the much higher intangible costs such as disruption, morale effects and functional losses from system deficiencies.

For our faculty practice at Weill Cornell, we attempted to address some of these issues by looking at bottom line measures of productivity. We implemented a commercial EHR between 2001 and 2007. We compared monthly visit volume, charges and work relative value units (wRVUs) before and after each provider’s EHR implementation go-live date. We also compared these data to a group of physicians who did not implement, though they had too many confounding variables to be considered formal controls. Our data matched the anecdotal impression in the industry showing that those practitioners who adopted the EHR had a statistically significant increase in average monthly patient visit volume (9 visits per provider per month), while the non-adopter cohort’s visit volume was statistically unchanged. Likewise, while both groups had significant increases in average monthly charges, only the adopters showed a statistically significant increase of this in wRVUs (12 per provider per month).

While these and other data suggest that EHRs do not harm productivity and probably help it, we believe the value of the EHR ultimately needs to be judged in the same way as an elevator in a skyscraper. It has become an essential tool of the trade. Too few ROI analyses ask what the ROI is of the analysis itself. Like the word processor and the typewriter, e-mail and the fax machine, or cars and the horse, the EHR will come and will transform ambulatory care. Today’s executives need to manage the change, not attempt to justify it.

That said, predicting the future direction of the ambulatory EHR industry is relevant. Vendors still rapidly come and go. The technology is evolving rapidly. What you buy today will be obsolete soon. Expect it and plan accordingly. Assume your vendor will change and protect your data and your investment in the knowledge it took to automate your practice. As a rule of thumb, only 20 percent of implementation costs are vendor fees. Not all of the remaining 80 percent is lost if you need to change vendors. Wise process redesign will deliver value now and in the future, independent of the specific technical platform. The delayed returns from automation will also translate from one system to the next, as they come from the EHR technology itself, not from any given brand.

The current round of vendor consolidation is marketed as a chance to increase interoperability, particularly with the biomedical devices made by the large conglomerates buying EHR vendors. But we may also see dramatic reductions in serviceability if these vendors oversimplify and cut the wrong costs. Will their size and oligopoly power destroy innovation? Consider the conflicting incentives facing just one vendor with multiple product lines and seemingly competing interests. Will a vendor that sells MRIs and EHRs support an EHR to help reduce the overutilization of expensive MRIs—a
business with far more profit potential than software? Large health IT software vendors are also employers who need to control medical insurance costs. Interoperability with competitors would reduce healthcare expenditures but might cause loss of market share. How large health IT vendors balance their own internal conflicts could have as much an impact on the future of the industry as technology itself.

The technology is also hard to predict. The big problems facing informatics for the past 35 years have not fundamentally changed. The nature of the human-machine interface, the physical limits of hardware and the complexity of medical vocabulary are still problems today. The expansion of the EHR outside academia only adds new problems of scale, configurability, flexibility, complexity, control, and ever-lower fault tolerance.

The next generation EHR, evolving today, is focused on integration, standards, ubiquity, mobility, reliability, quality, outcomes and, of course, workflow. Dangers to look out for include oversimplification, information overload, alert fatigue, overdependence and depersonalization. The next generation of ambulatory care is also emerging today full of potential opportunities and dangers. And as a key part of that future, the ambulatory electronic health record is surely both an opportunity and a danger.

FREQUENTLY ASKED QUESTIONS

Q: My consultants and vendor advise me to “keep it vanilla” to stay on time and under budget, but my physicians all demand customizations that sound clinically reasonable. How do I balance these conflicting demands?

A: Customization is often the most difficult management challenge of an implementation. If you want a single EHR to span diverse specialties, then you will have to customize to some extent, unless you are comfortable with ophthalmologists and cardiologists being reduced to a lowest common denominator, which is unlikely to result in high-quality care. Conversely, yielding completely to subspecialty customization can defeat the purpose of unifying the patient record and indulge wasteful, often dangerous intra-specialty variation that high-quality institutions are trying to reduce. There is no easy answer, and the answer will change as both computer technology and medical expertise advance.

Q: We can’t afford to build custom templates for every subspecialty workflow. The physicians currently dictate, but some of the ROI for the EHR is supposed to come from eliminating transcription costs. Can we use voice recognition instead?

A: Voice Recognition (VR) is perpetually three years away. Consider how the following sentence written silently might sound to a patient if it were spoken to VR instead: “The unkempt, malodorous, obese patient, appearing older than her stated age complained of an old liver.” Do you want to say this in front of her? Didn’t she really complain of a cold shiver?

Even if accuracy was improved, voice recognition is still expensive and time consuming to set up, slow to navigate and requires time for proofreading. In terms of long-term ROI, it produces text, not structured documentation, so the value of the data are lower, particularly in systems that otherwise offer advanced features like alerts, coding assistance, and complex reporting. Still, many physicians are accustomed to dictat-
ing their notes; for physicians who cannot type, this can be a tempting intermediate step toward a more complete EHR. Physicians who are not facile with computers will struggle just as much with voice recognition as they would a conventional EHR—so the applications are still limited. For users with upper extremity disabilities, this technology may be essential.

ADDITIONAL READING


REFERENCES


