

Electronic Medical Record (EMR) System Review

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ABSTRACT

This document examines the top six Electronic Medical Record (EMR) systems that are available on the market today: GE Centricity, AllScripts, NextGen, Amkai, E-Clinical Works, and E-MDS. The purpose of this document is to assess commercially available EMR systems and to gain insight into improving the design and functionality of *Armed Forces Health Longitudinal Technology Application* (AHLTA), an EMR system developed by the U.S. Department of Defense.

INTRODUCTION

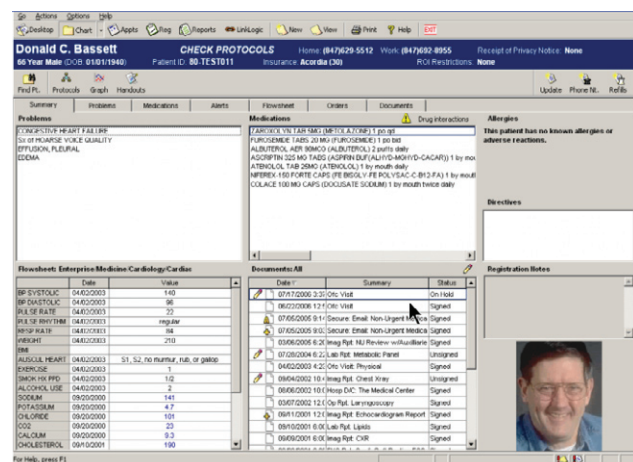
Over the period of four months, PIIM has conducted an extensive, preliminary research of nearly fifty off-the-shelf EMR and Electronic Health Records (EHR) systems and narrowed down the choices using the following criteria:

- Is the system comparable in its scope and capability to the current AHLTA system?
- Does the system provide features and modules that the current AHLTA system lacks?
- Does the system support standard EMR system features in a unique or more thoughtful manner than its peers?
- Does the system support new and progressive features that its peers lack?
- Does the system support a successful Graphical User Interface (GUI) solution that could solve AHLTA's current problems?
- Is the company an industry leader and have a significant lead in market share?
- Does the company provide sufficient online documentation and demonstrations for the system beyond marketing collateral?

This document provides a general overview of each system and its features and capabilities, an in-depth analysis of its Graphical User Interface (GUI) and usability factors, an assessment of its unique features, and a pros and cons list that identifies key issues and limitations regarding these EMR systems. As an addendum, the document also discusses strategic points for AHLTA as to how it can benefit and differentiate itself from these commercial systems.

Please note that this document is not a system performance review.

1. GE CENTRICITY



GE Centricity is part of the large GE Healthcare group, which offers a wide array of products and services from general and specialty medical diagnostic, imaging, and treatment tools to clinical information systems and performance consultation.

The Centricity series is offered under the “Healthcare Information Technologies” umbrella that includes solutions for EMR, clinical solutions, practice management, revenue cycle management, eHealth (patient portal), outsourcing/hosting, medical imaging, and services and education.

GE offers three main product lines for healthcare information systems:

- Centricity EMR, the core electronic health record management system;
- Centricity EMR for Specialty Care, the supporting suite of software that are available for 25 different medical specialties; and

- *Centricity Practice Solutions* (Practice and Group Management), its business management solution for small- and large-scale offices.

Additionally, GE offers two revenue cycle management systems—*Centricity Business* and *Centricity Enterprise*. For the purposes of this report, only the company's core product, *Centricity EMR* was reviewed.

URLS:

- <http://www.gehealthcare.com>
- <http://www.centricitysitevisit.com>
- <http://www.centricityforspecialty.com/cddemos/demogens.html>

1.1 GUI FEATURES ASSESSMENT

Centricity EMR interface is clearly and well organized by function. The overall architecture is sound and follows a discrete hierarchy, which reduces clutter and the number of “floating” features that do not have a clear place in the workflow.

The user is able to drill down for the information they need rather than having to sort through the information themselves. Furthermore, the hierarchy of information is reinforced graphically (top to bottom in sequence; then the information moves laterally), so there is no sense of displacement ever within the interface.

The interface is divided at the top-level as: “Desktop”, which contains front-office features; “Chart”, which provides patient records; and “Appts,” “Reg,” “Reports,” and “Link Logic” are other top-level items.

The “Desktop” summary screen provides precisely what is needed in an overview screen: the day's schedule (appropriately proportioned on the screen), a message box that provides correspondences that need to be answered, and a task box that contains documents and items that need to be attended to and the status of each item to ensure completion.

The “Patient Chart” is divided into subsections that are easily understandable and identifiable (e.g. “Summary”, “Problems”, “Medications”, “Alerts”, “Flowsheet”, “Orders”, and “Documents”). Each box of information is well-proportioned and organized as such that no real estate is wasted and all visible information is formatted to be legible and scannable.

Icons and features are bolstered by clear names; thus, no memory is required on the part of the user. Universal

and section-specific toolsets are appropriately placed at the top of the interface, where the user can consistently and regularly access them.

1.2 UNIQUE FEATURES

- The *Centricity* system was developed directly as a web-based application—which naturally allows accessibility from any location and reduces development time in that there is no need to build and maintain 2 separate versions of the interface. *Centricity EMR* is one of the rare “light apps” of its kind; most *EMR* applications are desktop applications with web/network connection capabilities.
- The system provides a wide range of decision-support tools and clinical guidelines (e.g. references, automated listings, etc.).
- The system supports the ability to “benchmark” clinical outcomes against peers, or track disease and treatment trends on a local and national basis. The user is able to search and match patients with similar conditions by simple criteria specification.
- The system focuses on flexibility, automation, and discrete data. Each symptom and procedure is identified further by its appropriate ICD-9 code, the official system of assigning codes to diagnoses and procedures published by the World Health Organization (WHO).
- The system provides a built-in E&M (Evaluation & Management) advisor that helps with coding accuracy.
- The system stresses consistent clinical vocabulary to increase the ability to compare against national medical references and terminology collections.

1.3 PROS

- GE *Centricity EMR* is the most easy to use and elegantly designed *EMR* system among those reviewed. The interface is informative but not overwhelming. It demonstrates logic and clarity.
- The software does not attempt to inundate the user by cramming too many disparate tasks into a single application. This *EMR* tool is exactly that—

a straightforward EMR tool. It does not provide features for the receptionist and office managers other than appointments and registration functions; even if those features are offered, they are clearly and separately compartmentalized and does not overwhelm the clinicians. Clinicians are able to share these functions to keep track of their schedules for their particular workflow, but they are not bogged down by gratuitous features.

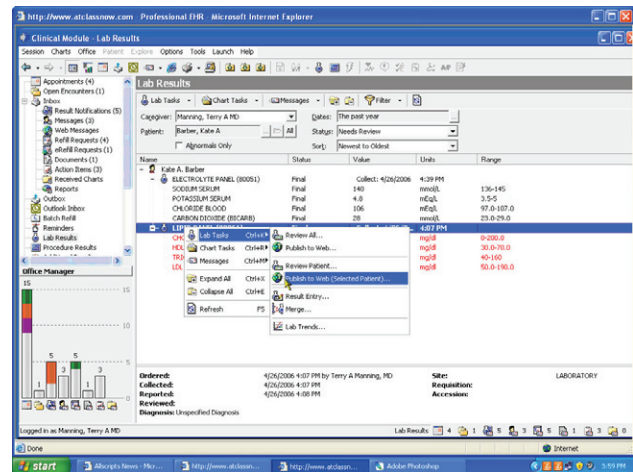
- The system provides on-site training services as well as access to community of users who share “best practice knowledge”.
- The system provides a customer showcase site (www.centricitysitevisit.com), where potential customers can choose to virtually visit “sites” that are most comparable to one's own practice or the facility's unique needs.

1.3 CONS

- By placing such heavy emphasis on discrete data and categorization, the interface can lead clinicians to potentially dangerous and limiting situations where unclassifiable conditions or new procedures can be dismissed or ignored.
- Although their EMR solutions are so simple and elegantly executed, GE Healthcare's websites showcasing their products were ironically a mess. It was nearly impossible to find the online demo for its EMR system and was only discovered out of sheer luck after 2 weeks of visiting their multitude of sites.

2. ALLSCRIPTS

Formerly *Misys* and *AllScripts*



Two well-established EMR system providers Misys and AllScripts have merged and are now collectively called *AllScripts*. Before joining AllScripts, Misys had offered two flagship products: *Misys EMR*, an electronic medical records manager, *Misys MyWay*, an enterprise-scale practice, EMR and claims application, and eight “a la cart” products, which were mostly available through MyWay:

- *Misys Connect*, a community connectivity service;
- *Misys eScript*, an electronic Rx system;
- *Misys Fast Services*, a business and revenue cycle manager;
- *Misys Homecare*, a solution for home care service providers;
- *Misys Patient Link*, a patient portal system;
- *Misys Tiger*, a medical practice management (schedules and payments); and
- *Misys Vision*, a MyWay for large-scale practices and HMOs.

AllScripts previously offered *HealthMatics*, a solution for smaller practices with 1–25 physicians, *Touchworks*, a solution for 25+ physicians, and *Hospitals/Management Services Organizations (MSO)* solutions for largest scale healthcare providers. In addition to its main line, the company offered a standard stock of supportive clinical

and business solutions for practice management, revenue cycle management, document management, electronic prescription, etc.

After the merger, the company has reestablished and re-branded its flagship offerings as *AllScripts Professional EHR*, *AllScripts Enterprise EHR*, and *Hospitals/Management Services Organizations (MSO)* solutions, which maintained its original name, while still offering a suite of ancillary software listed above.

For the purposes of this report the AllScripts Professional EHR software was reviewed.

URL: <http://www.allscripts.com>

2.1 GUI FEATURES ASSESSMENT

AllScripts Professional EHR provides the standard assortment of EMR system components such as patient scheduling and management, physician's desktop, patient encounter document generator, health maintenance, lab and procedure orders, prescription management, coding/billing/charge capture, reports, and security features.

However, the system stands out in its thoroughness, attention to details, and set of unique features. Overall, the system is relatively easy to use and navigate until the user gets deeper into the interface, particularly the chart and lab features.

Another item to note is that the AllScripts Professional EHR does not rely on a tab-based system that most EMR systems employ. If tabs are used, they are used minimally at lower-level features, such as the messaging tool, and not at the top level to divide main categories or features.

The system's primary grid structure, categorical division, and toolsets are to be noted for their efficiency, clarity, and consistency. The interface is divided by a toolbar at the top, a "Main Menu"-type window for all available features/categories to the top left, a "Manager" window that serves as a dashboard for tasks at hand on the lower left hand side, and the primary display area for main content.

This grid system is never broken and is consistent throughout the interface. Hence, the user is protected from jarring changes while navigating the interface and is always able to refer back to the tool bar, the main menu, and the Manager as grounding fixtures with which they can access all parts of the interface.

Despite its at-times ambiguous and unclear iconography, the toolbar is commendable and effective in that it highlights only the tools that are accessible within a particular category. Tools that are applicable to other categories are deactivated and marked in grey to indicate its unavailability.

However, the toolbar suffers from some clarity of meaning and memory requirement issues. High quantity of icons with no labeling and unclear meanings requires too much memory on the part of the user. Unless there is initial training or great jump in the learning curve, this flaw could potentially become a large usability concern.

The main menu, a standard, Windows-based directory tree solution, comes off perfunctory but, in this case, functions very cogently. List of categories and features are clearly marked and are readily and consistently available. It is a no frills approach that works, because the directory structure is not competing with other versions of the main navigation [as it is in the current AHLTA system].

The most valuable piece of GUI within the AllScripts system is its Manager feature. This dashboard feature, also referred to as "the Stacks" for its functional parallel to real-life stacks, allows users to quickly and continually view and keep track of which and how many tasks they have on hand.

Depending on the job of the user and log-in information, the name and the task categories for the tool changes, i.e. for administrative workers, the tool becomes an "Office Manager" with categories such as appointments calendar, requests, billing documents, and patient messages becoming available, and for physicians and nurses, the tool changes name to a "Patient Manager" with categories for open charts, labs, action items, and prescription refill requests becoming available.

The Manager feature also serves as a secondary navigation tool, where the user can access the needed category directly without referring to the main navigation system. This methodology works, because the system does not try to make the Manager feature into an explicit navigation system. It does not confound the user or compete with the primary navigation, and the action is natural and functional. The overall usefulness and cleverness of this tool cannot be stressed enough.

AllScripts Professional EHR loses some of its ease of use once the user gets deeper into the tool. For example, when the user accesses the patient chart and starts interacting with laboratory, procedural assessment, or medication features, the high volume of choices (e.g. symptoms, conditions, procedures, medication names, etc.) require the main display area to be divided several times over, thereby reducing legibility and increasing more involvement (i.e. scrolling) on the part of the user.

Secondly, pop-up windows become more frequent once the user gets deeper into the interface. These pop-up windows accommodate task execution and confirmation; however, managing these windows becomes a chore in itself.

2.2 UNIQUE FEATURES

- The system supports a “Manager” dashboard that allows the user to continually view and keep abreast of which and how many tasks are at hand.
- The system's use of MACRO technology enables physicians and clinicians to write notes quickly (similar to shorthand).
- The system supports the ability to conduct trend analysis on the spot from lab results.
- The system supports direct export capability for reports and messages to the patient portal or to internal staff from every point of the interface.
- The system supports anatomy and image based Physical Exam feature that provides a common symptoms template from which the physician can document encounters.

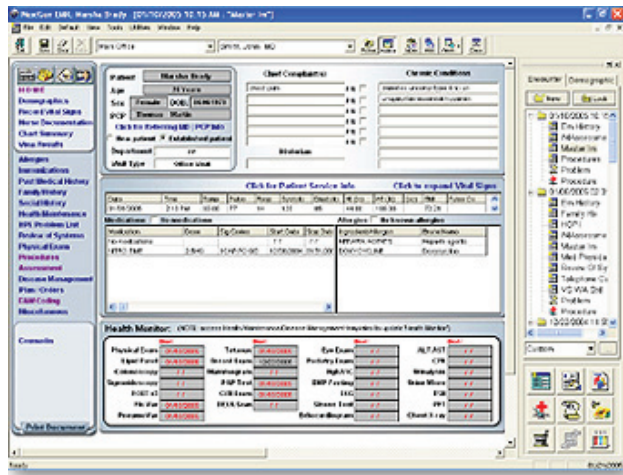
2.3 PROS

- The system supports consistent grid and navigation structure.
- The system supports clear information hierarchy and categorical division.
- The system supports minimal use of tabs.
- The system is one of the rare applications that effectively uses color without overwhelming the user. Color is used only to indicate various task states, urgency, or abnormal values.
- The system supports graphical/image-based modules ease some of the burden rendered from heavy texts. This type of system enhancement makes the interface more engaging.
- The system supports intuitive interface features and overall ease of use at the top level.

2.4 CONS

- The system suffers from complication in use at lower levels, which requires extensive training and significant leap in the learning curve before all features can be utilized fully.
- The system relies heavily on unclear iconography.
- The system supports repetitive features, such as eight different/independent types of messaging tools (instead of having a single messaging feature that can execute eight different types of messaging tasks).
- The system offers only twelve specialty EMR applications option (compared to NextGen's 25 specialty option), but focuses on industry specialization for applications on a larger scale (see product offerings list above).

3. NEXTGEN



3.1 GENERAL OVERVIEW

NextGen Healthcare offers two, flagship electronic medical records and practice management solutions—NextGen EMR and NextGen EPM—and three optional modules—NextMD, NextGen Community Health Solutions (CHS), and NextGen Image Control System (ICS)—that support the two primary offerings.

NextGen EMR and NextGen EPM are intended for both multi-provider enterprise or solo practitioner. According to the company press release, these two products are used by more than “20,000 providers at 800-plus physician practices worldwide” making it a formidable and widely distributed product in the EMR-systems marketplace.

URL: <http://www.nextgen.com>

3.2 GUI FEATURES ASSESSMENT

NextGen EMR is a truly comprehensive, enterprise system that covers all of the bases from clinical encounters to practice management to community network to patient portals.

Most importantly, the application functions as a non-linear system—making the GUI flexible and easy for clinicians to go back and forth between various modules rather than having to juggle several application at once just to complete general tasks. Overall, the system is still too Windows features reliant. The system is built up on a legacy of bad usability practices and this weighs heavily on how the user navigates the system.

Key functionalities within NextGen EMR rely heavily on iconography. Although icons for prescriptions, diagnostics, and laboratory results are clear, there are other

icons such as the “flower” or Windows-based functionality icons that are unclear in its meaning/function. Concerns regarding unclear iconography are obvious—chances for miscommunication become great but they also create situations where the user is expected to remember each icon’s functionality, which is a critical usability concern.

Also, supporting such an automatically populated catalogue could make the user too reliant on the default features. This can be dangerous considering some of the symptoms or conditions can be missed or dismissed without the clinician even realizing it, which could potentially lead to misdiagnosis.

3.3 UNIQUE FEATURES

NextGen EMR

- The system provides a well-executed, disease management and outcomes data management and customization option for over 25 specialties.
- The system also supports graphical data visualization and direct device connect capabilities that allow machines like EKG readers to the application for direct reads and recording. These two modules are necessary and useful features that increase efficiency and accuracy of data.

NextGen EPM (Enterprise Practice Management)

- The system supports an Advisor Screen that summarizes all activities for one’s practice from finances to tasks lists to daily schedule of appointments.
- The system supports a Home Screen feature that is customizable for job specificity or depending on access level.
- The system supports a task automation module that ensures work completion from beginning to end. This module is particularly useful in that it also instructs the user when and how to accomplish a task.

NextGen Image Control System (ICS)

- The system supports laboratory, EKG, x-rays and other clinical image-based results to be directly incorporated into medical records. The software works in conjunction with NextGen EMR and are very well integrated.

- The system supports abilities to scan, digitize, and manage paper records and directly insert them into the clinician's "workflow" process.
- The system supports a thorough search capability to find existing images within the database and batch processing capabilities make this an indispensable component within an enterprise suite.

NextGen Community Health System (CHS)

- The system allows healthcare centers, clinics, and laboratories around the community to collaborate and share information.
- The system's electronic referral system, an automatic template-based module that allows physicians to refer patients to other physicians in the network, is equipped with a workflow tasking system. This type of tracking component ensures that every step of the process (from referral to referral case closure) is executed and confirmed.
- The ability to add personal notes to each case additionally further safeguards each patient's case.

NextMD

- The system is a patient-provider portal that facilitates electronic communication and clinical data.
- A Personal Health Record (PHR) management system allows patients to be actively involved in their medical care process and have the most updated personal medical information available for other physicians as necessary.

3.4 PROS

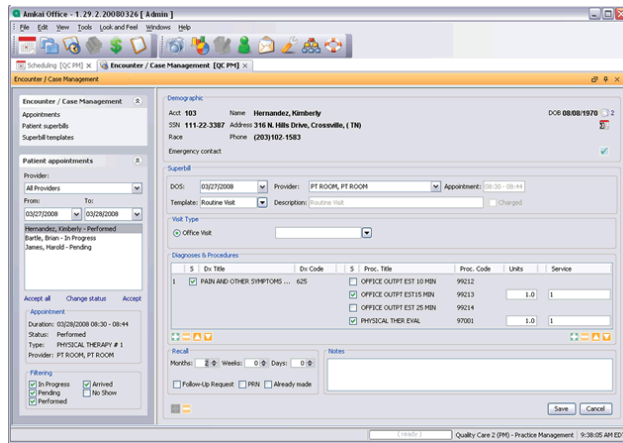
- The system supports an intelligent and well thought out structural framework.
- The system supports customizability. Being able to configure the system depending on a person's job is a very powerful feature (at least on NextGen EPM; this fact is unclear for other applications).

- The company focuses on and is committed to be compliant with national and industry standards and to develop new functionalities for interoperability and Continuity of Care Records (CCR).
- Single log in and application selection screen allows users to move freely between all NextGen products.
- Easy export features create reports that meet national and industry standards.
- The system supports a very thorough reference library.
- The system supports an extensive catalogue of built-in symptoms/conditions divided by anatomical regions as well as medical actions that need to be taken, such as assigning actions or instructions, prescribing medications, etc. This feature reduces time for clinicians.

3.5 CONS

- The system is built up on a legacy of bad usability practices, which strongly affects navigation and ease of use.
- The system supports unclear iconography which confounds purpose of key functionality.
- High level of automation without safeguard features for overriding functions poses danger.

4. AMKAI



Amkai offers two solutions under the name Amkai Enterprise: *Amkai Office*, an administrative management component, and *Amkai Charts*, an electronic medical records solution designed specifically for ambulatory surgery facilities and surgical practices.

These two products work together to provide clinical data management and electronic charting capability for the full duration of a patient encounter lifecycle from preadmission to postoperative reports.

URL: <http://www.amkai.com>

4.1 GUI FEATURES ASSESSMENT

Amkai Office

Amkai Office offers the standard set of practice administration tools such as scheduling, task management, financing/accounting tools, reporting capabilities and so on. However, it is in its architecture, design, and simplicity and clarity in organization where the interface stands out.

The "Clinical Document Management" screen provides a glimpse into Amkai system's patient encounter/case management scenario. Overall, the interface is well designed and clearly organized. This GUI provides the first case where icons without names or descriptions stand on their own and are vivid in their purpose.

The software's information architecture is profoundly simple: There are only six top-level categories (e.g. schedule, charts, task list, references, finances, and reports), and they are identified by simple yet effective icons at the top of the interface. Separated but next to these top level categories are standard universal toolsets that include capturing, graphing, forms, chat, email, utilities, network, and help icons.

The interface also has a unique capability that has not been seen in other EMR systems: a tab-based, multiple window feature that allows the user to access (and close) as many different top-level categories as they wish. The strongest part of this feature is that although the user has multiple tabs opened, the subsections/subcategories within each larger category are not overwhelming and are manageable. There are no tabs nested within tabs: The window provides all that is needed for that particular task—nothing more, nothing less.

Furthermore, the moderate but effective use of color and type treatment makes the data very legible and scannable.

AmkaiCharts

Much like its fellow product Amkai Office, Amkai Charts follows the same type of organizational and architectural principles. The variation in the color treatment gives a distinct identity to each tool; however, the way in which the interface is divided and laid out (top horizontal tool bar with strong iconography plus well-proportioned larger window) lets the user know immediately that these two products are related.

This particular "Surgical Case Dashboard" screen provides a snapshot of patient's surgical case. The system supports the ability to complete post-op documentation, or the "Operative Note", through easy templates for full PACU, Step Down, and Overnight Stay records, etc. The system also supports a built in, real-time alert features that warn physicians about patient risks and tracking indicators, e.g. for Deep Vein Thrombosis, fall, dehydration, medical interactions, allergies, scoring of safety to transfer, etc.

4.2 UNIQUE FEATURES

- The system is a surgical specialty software in addition to being an EMR system.
- The system supports a tab-based, multiple window feature, where the user can access different top-level categories concurrently.
- The system supports customizable pre-op admissions documents with electronic consent and signature capture capabilities.
- The system supports touch screen entry.
- The system supports clinical trend graphing ability.

- The system supports an “Audit Trail” feature—a tool that works “behind the scenes” to keep track of the evidence that one needs for proof in audit or liability cases by “tracking all entries and changes and views to the patient record” according to Amkai.
- The system offers in-office “Patient Kiosk” or web-based solution for patient data capture.

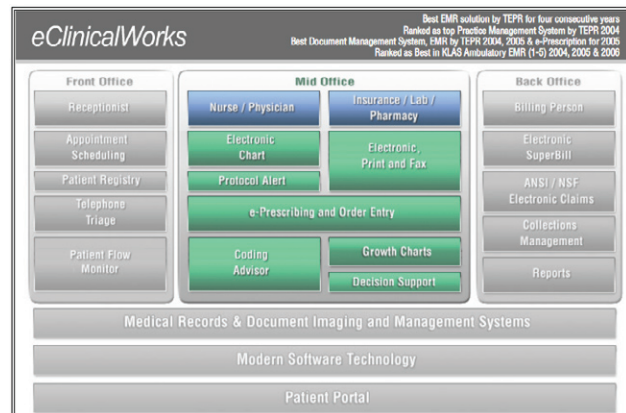
4.3 PROS

- Amkai software are very simple and straightforward systems without complicated hierarchy. They are highly usable as well as user friendly.
- Instead of providing supplementary software that plugs into an existing EMR infrastructure, Amkai Charts is specifically a surgically oriented EMR and patient management system.
- A unique tab-based system allows user to create their own workflow experience rather than be limited by the interface’s flow structure. This is another way of approaching customizability instead of the generic preferences setting or widget-type approaches.
- The touch screen capability during surgery procedure increase efficiency and eliminates the need to involve both monitoring devices and EMR; same goes for the patient kiosk solution.

4.4 CONS

- An overly simplified system can be a double-edged sword. It raises the question as to whether or not it is providing enough capabilities for a complete healthcare experience or not.
- Being so simple, the software lacks many of the sophistication and comparative benchmark models that tools with automated and discrete data functions can afford, i.e. GE Centricity solutions.

5. eCLINICAL WORKS



eClinical Works provides five major types of products: *eClinical Works EMR 8.0*, *Enterprise Management*, *Patient Portal*, *Electronic Health Exchange (eEHX 2.0)*, and its newest product, *Business Optimization (eBO)*.

In 2006, eClinical Works was rated #1 among providers by *Medical Economics*, who reported on ten different EMR solutions.

For this report, only the EMR 8.0 system was reviewed.

URL: <http://www.eclinicalworks.com>

5.1 GUI FEATURES ASSESSMENT

EMR 8.0 is the company’s flagship offering that can be accessed internally or remotely (via browser or PDA).

The system breaks down functionalities spatially/meta-physically by office tasks, i.e. by front, mid, back offices, and allows access through each category and all features through a somewhat primitive but graphically friendly “Home” page.

Front Office supports a standard selection of patient and office management modules, such as “Receptionist”, “Appointment Scheduling”, “Patient Registry”, and “Work Flow”, a task management tool that is scalable to the size of the work environment and is fueled by a “common foundation component” that facilitates seamless intra-module communication.

Mid Office provides an “Electronic Chart” feature, a library of XML-based templates that can be modified to practice-specific preferences, as well as and a dashboard system that provides an overview of patient data.

Mid Office features are further broken down by jobs and workflow, as follows:

- *Nurses*—Ability to check/record patient complaints and medical history, wireless/PDA connectability for point-of-service care, ability to check and record vitals from exam room, etc.
- *Doctors*—Ability to review patient vitals, medications, and allergies, prescribe treatment, charge capture, etc. “Consult Referral Notes” feature that generates custom letters in MS Word, ability to merge encounter attributes, ability to fax/email/print consult notes; “Decision Support” and “Growth Charts” features.
- *Pharmacy*—Ability to make 1-click selection for Rx, electronic fax feature for sending out Rx, ability to send Rx from exam room, electronic interface to Quest, LabCorp, CPL and other regional labs via HL7, etc.
- *Labs*—Ability to order and track lab results from exam room, link orders to “Assessments” feature, and ability to view/manage results anywhere.
- *Devices*—Interfaces to external machines such as, EKG, spirometer, holter devices, digital cameras, etc., ability to view results directly, and abilities to enter data and diagnostics, and scan.

Back Office supports the user through the entire billing lifecycle (claims, payment, refunds, statement, and collections). The system supports ANSI standards and provides the ability to generate statements that can be printed directly or outsourced for processing.

All Offices provide a “Documentation Manager” feature, a file management module that allows formatting and archiving single or multi-page files, scanned .tif, .gif, .bmp, video, fax, digital photo and voice files. The module supports annotation abilities so that physicians can make quick notes or draw on images for more thorough encounter documentation.

All Offices also supports the “Patient Portal” feature, a web-based module that allows patients to schedule their own appointments and update their own demographics information (Continuity of Care Records). The module also sends reminders and facilitates online communication. Additionally, the administrators can manage and collect account balances via this feature.

5.2 UNIQUE FEATURES

Front Office

- *Telephone Triage*—An option that helps manage and assign telephone calls as well as refill and urgent calls;
- *Patient Flow Monitor*—A console that allows clinicians to monitor patient traffic; time stamps, check in/out features, plus automatically refreshes status (good for continual monitoring and status updates)

Mid Office

- *Handwriting and Voice Recognition*—Direct dictation and handwriting digitizer, which saves transcription time;
- *Protocol Alerts*—Age, gender, RX, and diagnosis-based warnings system;
- *Patient & Rx Education*—Ability to generate reports for patients on health conditions and Rx education, highly refined search capabilities such as save searches and alerts

All Offices

- Ability to draw on images/xrays, which goes beyond mere textual annotation; being able to manage account finances online via the patient portal.

5.3 PROS

- The system interfaces with most major hospital networks including Siemens, IDX, Epic, and Meditech, increasing its overall utility and value for long term growth and expansion possibilities.
- The company places emphasis on standards for CCR by integrating patient portal with EMR system.
- The system maintains tightly integrated so that it communicates and supports a complete healthcare experience.
- The system supports a unique way of grouping tasks by job titles rather than inundating every user with features that are not necessary for their workflow (although somewhat primitive).

- The system supports refined search capabilities and ability to create alerts for patients that need closer monitoring.
- The system provides some very well thought-out features at lower levels of workflow; however, it gives the impression that they paid more attention to the details than the larger picture. The patient flow monitor, voice/handwriting recognition, protocol and specific patient alerts, ability to draw on images, being able to pay your bills online, etc. are all very solid and unique features not found in their competitors' applications.

5.4 CONS

- Overall, there is no consistency in the GUI. Each of the applications has its unique identity and visual style (albeit a rough one) that makes it seem as if they are all separate applications from entirely different companies. Hence, there is no unified user experience.
- Although very comprehensive, the dashboard feature for a patient medical record maintains a haphazard architecture that offers too much information for very little pay off.
- The interface relies too heavily on pop-up windows to provide detail information. If one were to drill down for data, simply managing the multiple windows for each level of granularity becomes a difficult task.
- Additionally, the overuse of colors to make distinctions end up affecting the meaning and significance of the information. Majority of the icons and boxes all carry heavy, "alert"-type colors that diminish what actually is important information and what is not.

6. e-MDS

Founded by a group of physicians in 1996, *e-MDs* offer a wide array of EMR, clinical process and practice management solutions that have been developed by those with a primary background in medicine. The company was established by physicians and clinicians who were in the market for an EMR solution for their clinic and found existing EMR solutions to be too pricey, inefficient, and unsuitable for their needs.

Accordingly, *e-MDs* offer their products as both an interoperable suite or as individual modules that can be acquired "à la carte" to suit individual practice's wants and resources. Additionally, all of its applications are tested and used on a daily basis at the founding physicians' practice, Northwest Diagnostic Clinic. *e-MD's* product line includes:

- *e-MDs Chart*, an EMR and documentation system with a set of well-thought out fetures;
- *e-MDs Bill*, a standard billing and financial management software;
- *e-MDs Schedule*, an administrative, task management tool that contains a lot of warning and alert features to keep staff on track. The application also contains data analysis tools to keep track of no show/cancellation/appointment histories, etc.
- *e-MDs Tracking Board*, a user-defined dashboard feature for summarized overview and situational awareness;
- *e-MDs DocMan*, a file digitizer and management system;

- *e-MDs Rounds*, a mobile solution for above tools;
- *e-MDs OB Module*, a system designed specifically for obstetrics and gynecological practices; and
- *e-MDs Patient Portal*, an online patient health record manager.

URL: <http://www.e-mds.com>

6.1 GUI FEATURES ASSESSMENT

e-MDs Chart provides a standard set of EMR application features, such as:

- Visit Note, a single-screen overview of patient's health summary and visit notes;
- Refill Grid, an electronic, prescription refill system with a simplified, 3-click completion process;
- Template Editor, a set of specialty and job-specific templates and customizability options; and
- Evidence-based guidelines and "disease-management ticklers", a reminder/alert feature, that serve as references to physicians for more informed decisions.

The Chart application can be accessed locally on desktop units or remotely via mobile phones and pocket PCs through *e-MDs Rounds* application.

The critical flaws of *e-MDs Chart's* GUI are its crowdedness and lack of hierarchy and clarity in its organization and presentation. The application attempts to pack too many features that compete with each other, which is the direct result of not having a strong sense of informational and functional hierarchy.

Although the tool is separated into four large categories (e.g. "Reminders", "Visit/HS", "Chart View", and "Flowsheets"), there is no clear sense of where within the tool a user is, i.e. there is no explicit or perceivable graphical indicator that lets the user know which category he or she is accessing.

Moreover, the toolbar competes with the four main categories and further obfuscates the top-level categorization. The only distinction the tool provides is a very minor and dismissible selected button state, which is simply not enough of a differentiator for identifying such a high-level category.

Additionally, the heavy use of unclear iconography in the main tool bar as well as detail windows clouds meaning and actual functionality of features. Excessive reliance on iconography can be attributed to the desire on the part of the designers and developers to include as many features as possible within a single screen. The same can be said for the collapsible/expandable windows, a GUI solution on which *e-MDs Chart* also depends very heavily.

The need to cram in so many features as possible within a single screen stems from the fact that no high-level information architecture was considered and implemented in the first place. To use a simple analogy, if enough containers were created, then there will be no need to overload each container.

That being said, the intent for a "compact" and efficient solution, although admirable, actually works against *e-MDs* in that the user actually has to go through more steps in order to access the information they need.

For example, the purpose of the Visit Notes screen is that the user is able to scan and quickly view important summary information. However, the number of collapsible/expandable windows makes easy scanning impossible. Instead, the interface requires the user to be more (inter)actively involved to acquire basic information when that is not the purpose for accessing this feature.

6.2 UNIQUE FEATURES

Despite its essential flaws, the application does provide a slew of unique features:

- *Flow Sheets*, a linear tracking tool that allows one to view patients' vitals and clinical history over time. This feature also comes with a graphing ability, which can provide additional insight for diagnostic purposes;
- A direct lab results integration system that allows results from well-known labs like Quest and Labcorp to send results electronically to the system;
- The use of Current Procedural Terminology (CPT), ICD-9 and HCPCS databases, which the interface directly ties to its billing application, makes the clinical flow process more efficient and less prone to errors;
- The *Differential Diagnosis* (DDx) tool provides the ability to document differentials connected to a diagnosis. The tool can be used to substitute a diagnosis for conditions that are not billable or codable;

- Editable English and Spanish patient education handouts;
- *Fax Server*, a tool that allows documents to referring physicians or signed prescriptions to pharmacies to be directly faxed over with signatures;
- *Rules Engine* that allows tracking of overdue preventive care, drug/disease management concerns, and immunization situations to generate new sources for revenue as well as provide better and optimal patient care scenarios; and
- An editable *medical art module* that allows medical images to be annotated and sketched on to provide better consultation and documentation abilities.

6.3 PROS

- The system places heavy emphasis on affordability, access, and real-world utility.
- The in-house usability testing makes for faster turnaround rate for changes and improvements.
- The system supports considerate and useful minor features that make the tool more appealing.
- The system supports a direct lab results integration component, which is an indispensable feature for future EMR tools.
- The system supports a Differential Diagnosis capability, a necessary component for an application that relies on discrete data. This feature is that additional measure that can be taken to decrease medical and billing error chances that other applications, such as GE Centricity, does not take into account.
- The system supports bilingual capability for patient education handouts, which is a very forward-thinking consideration.
- The system supports predictive and tracking modules, such as Flowsheets and Rules Engine, which are also very progressive and beneficial in its utility.

6.2 CONS

- The system is plagued with lack of clear hierarchy, overly packed screens, and ineffective GUI solutions—making usability a significant issue for this application.
- Although available as an interoperable solution, the excessively individual or independent nature of each application makes the overall e-MDs line of applications seem less integrated and comprehensive.

7. A SUMMARY OF BENEFITS AND DIFFERENTIATORS FOR AHLTA

This section summarizes how AHLTA can benefit from from each system reviewed as well as how it can differentiate itself as it positions itself within the EMR field.

7.1 GE CENTRICITY

Clearly, GE is an industry leader who is heavily invested in the healthcare community. It has a firm grip and in-depth knowledge of the field and can draw from its many intra-company resources and devices. As such, their EMR solutions provide an unparalleled level of interconnectivity and interoperability to work as a systematic whole rather than as a standalone, off-the-shelf solution.

Furthermore, Centricity EMR is one of the most well-designed and well-thought out application even outside of the EMR industry. The tool demonstrates mastery of both the basic EMR needs as well as the necessity for innovation, i.e. benchmarking and comparison capabilities. And GE accomplishes this without bells and whistles. If there was a EMR solution to measure up to, this would be it.

The differentiator for AHLTA would be that it would need to find a way to improve upon the discrete data component, which is very beneficial and necessary but could also lead to physician pitfalls.

7.2 ALLSCRIPTS

Most features within AllScripts Professional EHR system are not revolutionary; however, these features are executed well. AHLTA can benefit from the structured and consistent nature of this interface; however, it can also learn from the mistakes it makes at the lower levels, where a plethora of information and options compel designers and developers to resort to “back-up plans” such as pop-up windows in order to simply “make things work”.

AHLTA can differentiate itself by having a clearer picture of the tasks at hand and more thorough look at reduc-

ing the follies that can come from trying to deal with vast amount of information. A better information architecture that allows plenty of room and latitude for necessary but overwhelming amount of information such as conditions, procedural, and medications lists is crucial to having a successful EMR application.

7.3 NEXTGEN

AHLTA can benefit from the NextGen system in recognizing the level of offering, i.e. types of features and system that are required, that is necessary for a top-quality, enterprise-level product.

NextGen covers all of the bases, whether the system is used by small practices or large scale HMOs. It is thorough in its research and presentation. NextGen also offers the Image Control System (ICS) software that is unique.

AHLTA can differentiate itself by observing and going through the current NextGen system and figuring out ways to build a non-platform restricted/cross-platform software that does not have to build up on a legacy of bad usability practices. Also, offering a customizable and flexible system for different types of users within a unified framework is key in creating a successful EMR system.

7.4 AMKAI

AHLTA can benefit from Amkai products by reviewing how a minimal but effective system compares to a highly sophisticated system, such as GE Centricity or Next-Gen systems. We can also learn from its approaches for straightforward iconography, simple architecture, and unobtrusive information hierarchy. Also, their unique features list offers some great ideas for us to look into, such as the audit feature.

The differentiator is that AHLTA most likely will not be in direct competition with Amkai, as it will not be focusing on ambulatory surgical providers. AHLTA can learn from Amkai's best approaches, but with expansive knowledge of a wide range of small to large-scale solutions, AHLTA will be able to create a more efficient, useful, and adaptable tool for practices of any size.

7.5 eCLINICAL WORKS

AHLTA can benefit from eClinical Works in their attention to details. AHLTA must think of and invent unique features or offerings that no other EMR systems provider has in addition to having a solid overall EMR and EPM system. AHLTA must focus on features that introduce new ways of using technology to increase productivity and user experience at every level— not just in the details.

AHLTA can differentiate itself from eClinical Works by conceptual, architectural, and stylistic consistency. Although they provide a complete functional experience, the critical flaw of eClinical Works' offering is that they do not provide a cohesive, usable experience.

7.6 e-MDS

AHLTA suffers from the same type of usability flaws that plague e-MDs systems. By recognizing its own shortcomings and examining e-MDs' interface for further reference, the AHLTA system will be able to improve its usability and usefulness significantly. Moreover, incorporating the "checks and balances" system such as the Differential Diagnosis component, or predictive models and bilingual capabilities will allow AHLTA to meet what will become standard requirements in future EMR systems.

The means of differentiation will be to find an ideal balance where separate applications come across and function as a single, integrated enterprise unit. AHLTA will have to create separate modules, there is no doubt; however, most EMR vendors seem to develop each tool separately and try to integrate them as an after thought. However, AHLTA must have foresight and have a clear agenda and planning from the onset, i.e. recognize which solutions the system will provide and how it will implement them and in what sequence prior to delving into full-scale development mode.