Recommendations for the Selection and Implementation of an Emergency Department Information System

(Selecting a Machine That Goes Ping)

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Emergency medicine is a potential minefield for automation. Emergency Department Information Systems (EDIS) can aid or impair the delivery of patient care, can save lives or end them.

Health Care Information Systems are frequently compared with air traffic control (ATC): if such a critical industry can cut wait times with fewer staff, improve customer satisfaction, and above all realize significant gains in reliability and safety, then surely something as simple as a small urban Emergency Department can do the same.

The analogy soon falls apart:

> "ATC is a well-bounded domain that follows prescribed procedures. When circumstances become marginal and overtly threaten safety, it is acceptable (and expected) that operations are suspended. The automated systems that support ATC are relatively well suited to such well-bounded problems. Even in this well-bounded setting, automation has not proven to be a panacea. Controllers frequently rely on paper artifacts, and an ambitious advanced automation system effort to upgrade the U.S. ATC computer system in the mid-1980s was 'sunk by unrealistic specifications and human factors difficulties, among other problems.'
>
> In contrast with ATC, the ED setting is highly variable, evanescent, contingent, uncertain, poorly bounded, resource constrained, and beholden to many external influences. For example, patients just "show up." In order to reconcile care resources with patient care demands, ED teams routinely engage in fluid, dynamic cognitive activities that require flexible, reliable artifacts to support them. They seek, track, digest, calibrate, probe, evaluate, verify, and share information. They also plan, speculate, replan, and make trade-off decisions. No circumstances make it acceptable to suspend patient care. Because of this, practitioner teams have developed a range of sophisticated strategies to manage the balance between work and demand. In order to succeed, automation needs to be a team player in the ED setting."[1]

Large-scale failures abound. Adapting third-party EDIS solutions to a specific environment involves a large investment of time and money; ongoing costs often discourage the customization and updating required to make a system work. End-users are often far removed from the implementation, and as such, systems may not mirror or enhance work-flow, but frequently complicate it. Automated systems that work on smaller scales may buckle under the demands of a full-sized implementation handling hundreds of thousands of events, and thousands of data fields – some of which individually containing multiple megabytes of data – per event.

Automated systems are "brittle." They may decrease the frequency of small failures – but "when systems do fail, they do not degrade gracefully. Instead, they fail catastrophically and without warning."[1]

Additionally, patient presentations are infinitely varied, problems are often subtle, and difficult situations may force the adoption of less-than-ideal compromises. EDIS implementations frequently ignore these subtleties. Regimented structures can run counter-grain to the needs of a "live" department, especially under strain. Technology "can give the illusion of helping practitioners while at the same time creating a new layer of burdens and complexities."[1] "Clumsy" automation creates extra steps: it wastes caregiver time and creates frustration, impedes patient care, and can endanger the patient.

Society of Academic Emergency Medicine Consensus Conference on Emergency Medicine Information Technology

The primary purpose of a clinical information system is straightforward: show all relevant information. Show it everywhere. Make it clear. Make it concise. Make it fast. Make it easy.[2]

Fortunately, the essential components of an effective EDIS have been addressed by the recent consensus conference on this subject,[3] reported in a special issue of Academic Emergency Medicine: Informatics and Technology in Emergency Care (Volume 11, issue 11, available free of charge at http://www.aemj.org/content/vol11/issue11/).

This document follows their recommendations in basic outline (a few have been omitted, and the order rearranged, to better reflect our circumstances). Detailed requirements have been organized and itemized in the form of a Request for Proposal – see Appendix A. Emergency Department Information System: Request for Proposal.

Also attached are:

- Appendix B. Overview of EDIS Solutions
- Appendix C. Recommendations for EDIS Implementation
- Appendix D. Optional Components and Upgrades

EDIS Database Structure

Information systems should adhere to open database standards that allow any or all data to be retrieved and exported by authorized users. A data dictionary and methods for decryption should be supplied.[3]

EDIS vendors frequently use proprietary database formats; further, no standardized schema exists for logging thousands of data fields within these databases. Results may be stored in different forms (integers, floating-point decimals, characters, "blobs", as references to external files, etc.) in logically named fields, or simply in fields identified by number or alphanumeric ID, and can be stored in any of a number of encrypted formats.

Regardless of how powerful the built-in analytic tools, open database standards are essential, as are database dictionaries cataloguing the entire database structure, field names and result types. No vendor can anticipate every query a clinician, a manager or researcher can envision. For example, when a severe influenza-like illness strikes, it may become imperative to flag every patient with cough, headache and fever, listing them by name, phone number, and postal code – to localize potential infectious foci, and conduct contact tracing. Coding the appropriate SQL query takes only a minute or two, provided the database handles such sources.

There are two more reasons for an underlying, open database structure. First, these are standardized, robust, regularly upgraded, and typically have been stressed by hundreds or thousands of simultaneous users in large-scale applications, and their strengths and weaknesses are known. Second, in the event of a particular vendor's demise, the data is not locked into some obsolete application, but can be readily migrated to a newer EDIS.

Data Standards

Information systems used in EM should adhere to accepted data standards and be designed to integrate with other systems using standards-based messages.[4]

A number of data formats are or are becoming standard for EDIS. Recommendations, as per the 2004 SAEM Consensus Conference,[4] are:

- Recommended data elements: DEEDS (Data Elements for Emergency Department Systems, sponsored by the Centers for Disease Control and Prevention)
- Recommended representation: XML formatted per HL7 Clinical Document Architecture, with data structures derived from the HL7 Reference Information Model
- Coding for billing: minimum ICD-9 (diagnoses) and CPT-4 (procedures), with ICD-10 recommended
- Coding for vital signs and laboratory results: LOINC (Logical Observation Identifiers, Names, and Codes)

- Recommended nomenclature for expressing clinical observations: SNOMED CT (Systematized Nomenclature of Medicine)
- Systems should support XML-based messaging. Message formatting should be HL7 version 2.x or HL7 version 2.X-XML; version 3.0 recommended when completed
- Interfaces to biomedical devices: consistent with the IEEE 1073 specification

Ideally, these would be adapted to the Canadian situation:

- Presenting complaints: CEDIS
- Diagnostic coding: ICD-10-CA
- Orders and Procedures: CCI (Canadian Classification of Health Interventions)

For further specifics, refer to Appendix A. Emergency Department Information System – Request for Proposal

Minimum Required Data Fields for an EDIS

Emergency departments should be provided with the data necessary to manage their departments administratively, academically, and for clinical care. Data should be provided in a standard digital format. At minimum, data to be provided include the following:

- *Admission/discharge/transfer information*
- *Performance metrics (time of arrival, time to triage, time to bed placement, time to room, time to physician first seen, time first medication given, time orders placed, time orders completed, time bed requested, time bed obtained, time transferred to floor, and so on)*
- *Any and all needed laboratory data (current and historical)*
- *Medication administration data (current and historical)*
- *Archived medical records*
- *Billing data*
- *On-staff physician contact information (e.g., office, home, and pager, addresses)* [3]

These, of course, are minimum required data. Providers require immediate electronic access to all current and legacy patient data, including lab results, radiography and other diagnostics, and ideally consultations and outpatient and inpatient medical records, from within the entire hospital IT infrastructure. Managers and researchers should be able to query all data for a specific ED visit, subsequent outcome data, and aggregate data for the entire department. When new data elements are required, it should be possible to add these easily.

Additionally, metrics should be logged automatically, with little or no manual entry from providers. Physician rosters, on-call schedules, emergency services, Public Health, disaster plans, policies and procedures, administration on-call, etc., should be readily accessible, ideally from within the hospital intranet.

User Interface

Clinical systems should help clinicians to see the right amount of the right type of data wherever and whenever needed. Data presentation should be context-driven, and clinicians should be able to change what the system shows them in any given context, showing or hiding specific data elements to meet current data needs.

A system should be learnable and usable for basic clinical functions with little or no formal training. Functions necessary for clinical care should be memorable after a hiatus in system use.

Clinical systems should reduce to a reasonable minimum the number of steps required to obtain any information. From a main screen, complete test results for any patient should be available in one or two steps.

Clinical information should be accessible in the shortest possible amount of time. Most results should be available with subsecond response times.

Data from disparate sources should be aggregated or joined for completeness whenever possible so that clinicians are not forced to go to multiple different systems to obtain important information.[2]

The above recommendations are so obvious, they need little elaboration. Sub-second response times refer to time from selecting the results button or icon from a caregiver's patient list, to the time in which these are displayed.

Interruptive alerts and alarms should be reserved for high-severity events. Other categories of information should be available for review by users but should not interrupt physician workflow.[5]

Interruptions frustrate users. Frequent confirmations and warnings for relatively unimportant matters (i.e. minor drug interactions) are ignored, and when interruptive warnings for low-risk interactions cause users to ignore more critical warnings, they put patients at risk. The insistence on interrupting user flow with minor concerns not uncommonly leads to failure of EDIS implementation. Alert levels and type of warnings should be easily locally modifiable, and not require vendor intervention.

Computerized Physician Order Entry (CPOE)

Computerized physician order entry systems for the enterprise often do not function well in the ED, leading to a reduced quality of care. CPOE systems intended for use in the ED should be designed specifically for the ED.[5]

"There is a heavy social cost associated with compelling clinicians to perform data entry tasks. There is scant evidence to show that computerized physician order entry actually improves clinical outcomes, and it is possible that deploying computerized physician order entry could increase certain types of errors."[2]

The Emergency Department is highly unpredictable; times of high volume and high acuity occur almost daily. Forcing ED physicians to negotiate complex lists of investigations and medications – many of them not appropriate to the emergency setting – or requiring each order to be manually marked stat create obstacles to timely patient care, especially when the system is stressed. If CPOE fails, it will do so in the ED.

For effective integration into physician workflow, DSS and CPOE must be widely available, both at the bedside and at other locations throughout the ED. Mobile wireless technologies are an essential component of this widespread availability in an intensive clinical environment such as the ED.[5]

In the Emergency Department, clinicians frequently receive information that require immediate action. This is not an area where hospitals can cut costs: without ubiquitously available hardware and software resources for physician patient lists, one-click access to lab results, diagnostic imaging, and CPOE, clinicians will become frustrated, patient safety will be compromised, and implementations are likely to fail.

CPOE, Clinical Decision Support and Evidence-based Medicine

Clinicians avoid fragmented systems that necessitate changing applications, changing geographic location, or redefining context to seek out data for each task. Seamless and timely integration of comprehensive decision support into all elements of clinical workflow, documentation, CPOE, and clinical information systems is a highly desirable goal. [5]

As of December 2004, The National Library of Medicine has already catalogued 566,964 article citations for the biomedical literature, for 2004 alone.[6] It is estimated that between 44,000 and 98,000 deaths occur annually in the U.S., due to medical error alone – more than those from than from motor vehicle accident, breast cancer, or AIDS. Total costs, in lost income, disability and health care costs are estimated to fall between $17 and 29 billion.[7]

Clinical decision support reduces errors and expedites care, as well as decreasing costs and saving lives. It is highly effective – when automatic and seamless. EDIS-based algorithms can suggest diagnoses; chief complaint, user impressions, diagnoses, etc. can trigger the appropriate protocol(s). For example, the system can auto-calculate a community-acquired severity pneumonia severity index, then present the user with a list of single-click selections to automatically order the appropriate, weight-based, renal-function adjusted medications, cross-checked against allergies, medication interactions, and other contraindications. An EDIS can automatically flag a patient as a febrile neutropenic when an abnormal WBC returns, and present caregivers with a list of selectable suggested investigations, as well as appropriate antibiotic selections for that patient.

All clinical decision support should be evidence-based, and link seamlessly to the underlying evidence.[5] Basic CPOE clinical decision rules should be provided by the vendor, though EDIS decision support rules and system alerts should be readily modifiable, locally, without requiring vendor intervention or specific programming skills.

Not immediately applicable to the selection of an EDIS today, but potentially very important, is the SAGE (standards-based, Sharable Active Guideline Environment) project, at http://www.sageproject.net/. This collaborative project aspires to create a universal framework for encoding and disseminating electronic clinical guidelines, from diagnostic algorithms to complicated clinical trial protocols. These will be centrally warehoused, regularly updated, and could be easily integrated into an EDIS via a standard interface, and adapted as necessary to a local environment – *if the EDIS allows.*

The latter proviso does raise a point that is immediately relevant: that an EDIS be regularly updated to meet evolving standards, have a largely trouble-free upgrade record, and that the vendor has both the financial stability and programming resources required to continue to do so.

CPOE and Medication Checking

Medication errors probably account for more than 7,000 deaths annually, in the U.S. Even when no actual harm occurs, such errors increase hospital costs of by an average of $4,700 per admission, about $2.8 million annually for a 700-bed teaching hospital, and by about $2 billion for the entire U.S.[7] Allergy-related errors occur frequently, with physicians unaware of the patient's allergy the leading cause – and automatic flagging of inappropriate prescribing at the time of order entry can simply and significantly alleviate this problem.[2]

EDIS systems can and should seamlessly provide drug interaction, allergy, and clinical-context checking (i.e. pregnancy, acute renal failure), and adjust as necessary for age, weight, renal and hepatic function, etc. Where appropriate, the system can suggest alternatives based on cost, better side effect profiles, etc. Further information for all medications should be only one click away.

Clinical Decision Support and Corporate Intra/Internet Access

Clinically important information resources and references available over wide area networks provide an important cornerstone for clinical care. Full Internet access, or at least access to all major general medical and emergency medicine–specific Web sites, should be available throughout the clinical area. If full Internet access is not provided, decisions regarding resource accessibility should rest with the ED chair or designee.

Clinical practice requires immediate access to recognized, authoritative reference materials and calculation aids that are up to date and represent best evidence. Important electronic clinical resources that should be available for all emergency medicine clinicians include, at a minimum, appropriate emergency medicine reference texts, a medication reference, MEDLINE, a pregnancy calculator, common medical formula calculators, a clinical guideline repository, a medical image repository, and other resources the ED chair (or designee) deems necessary, including resources available only through institutional subscription.[5]

The EDIS should also allow easy on-line searching of local guidelines and policies and procedures, as well as access to clinical calculators, toxicity nomograms, etc., so that these may be selected and incorporated, even when not automatically triggered by the system. Finally, access to the e-CPS (electronic version of the Compendium of Pharmaceuticals and Specialties), PubMed, etc. should be immediately available from within the clinical context.

The Physician Medical Record

There are not strong data supporting a particular documentation method, but ED clinical documentation should be electronically retrievable.[8]

Clinical charts take many forms: unformatted longhand writing, templated paper charts, structured and unstructured dictation, and electronic medical records (EMRs) created using voice-recognition, typing, mouse, light-pen, or touch-screen selection, or some combination of these. There is little evidence comparing the effectiveness of these methodologies. Regardless of the method, any clinical document should be converted into an electronically retrievable format.

Ideally, physician charts can be generated at the bedside, and here, paper charts still excel. Single-page forms can be printed with bar-codes identifying patient and unique encounter ID and seamlessly scanned into the EMR upon completion. Data storage takes place as a high-resolution digital image: optical character recognition software is imperfect at best, and unlikely to decipher most physician writing. Unfortunately, from a data-collection perspective, paper charts are useless, and illegible records remain illegible.

EDIS solutions typically offer template- or menu-driven charting – very easy to do poorly, very difficult to do well. With thousands of potentially relevant findings for any given patient encounter, allowing clinicians to rapidly communicate their thoughts while still providing a depth of choice and a usable interface is difficult. And many clinical encounters defy templates: "patient rolled 20-ton snow plow," "bitten by squirrel," etc. The ability to do free-text, quickly, is essential within the electronic chart.

This aspect of the EDIS *warrants the closest scrutiny*: poorly-implemented electronic methods create significant frustration, and can more than double the time required for documentation, with obvious detriment to patient care. If formal training is required to use a system, it requires redesign. Inexperienced users should be able to accomplish simple tasks, quickly. Complex or inexact data entry results in charts that do not reflect the clinical presentation. Cumbersome data entry forces physicians to leave a minimal, poor-quality record and decreases their availability for patient care.

Forcing physicians to adopt into electronic charting, especially with dysfunctional systems, has led to multiple EDIS failures and deinstallations. *Poorly-implemented systems should not be adopted.* When they are, they are often abandoned soon after.

Voice-recognition is still flawed, especially in the setting of significant ambient noise, i.e. the Emergency Department. Accents and poor diction foil software, and software and users frequently need re-training. In addition, bed-side dictation is difficult or impossible in many situations: with psychiatric patients, intoxicated patients, or any patient where the dictation would then have to explained word-for-word.

For the time, it appears best to allow several modes of physician charting: automatically scanning a digital image of a paper physician chart (while still implementing computerized physician order entry) and rigorously-evaluated template- or menu-driven charting, with option to input free text via keyboard or touch-sensitive tablet PC screen, and optionally voice dictation, if a quiet environment can be provided, and if time-away-from-patient can be minimized.

Integration of Emergency Department Equipment

Emergency Department equipment – from monitoring/telemetry to point-of-care testing – should output data that is automatically time-stamped and stored to the appropriate database fields. Unfortunately, the vast majority of devices do not export data in standard format, and interfaces need to be written to integrate device output into the EDIS. Ideally, the selected EDIS will have as many interfaces as possible already implemented, for equipment/equipment vendors currently in use at our facility.

A detailed listing of systems and data sources to be considered for integration have been tabulated by Barthell et al.,[5] viewable online at http://www.aemj.org/cgi/content-nw/full/11/11/1142/TBL2.

Newly-acquired equipment should always output data in digital format, storable within the EDIS. Ideally, all new acquisitions will already have an interface for the selected EDIS. Additionally,

Emergency department leadership should be encouraged to strategically acquire mission-critical equipment that is networked and capable of automated feedback regarding functional status and location.

Supported functions should include, but are not limited to, battery charge, need for repair, need for routine maintenance, and need for supply refill.[3]

Hospitals plans for managing and maintaining equipment are often manual, and time-consuming. They can be neglected or forgotten, and when equipment fails, patients can die. Thus, an EDIS should support self-monitoring mission-critical equipment, and such equipment should be procured as these become available. At the very least, an EDIS system should have a regular, trouble-free upgrade record, and the vendor should be committed to enhance its product as standards evolve, and the financial stability to expect that it will be able to do so.

Critical Event Warnings

Emergency departments should have software-based automated alarm functionality available for monitoring their data from clinical and nonclinical software systems.

- *Thresholds should be user configurable based on chosen rules*
- *Alarms should act in a real-time fashion*
- *Triggered alarms should be able to contact individuals by e-mail, pager, or fax and should be scalable to alert multiple individual*[3]

Humans are unreliable. Humans are especially unreliable late in the night, as Bhopal, Chernobyl, and Three Mile Island will attest.[9] Significantly elevated potassium values, or a computer-generated ECG interpretation of acute MI should trigger automated alerts to the attending physician, via pager, PDA, or some other mechanism. Threshold triggers for alarms should be user-configurable, support multiple levels of alert, and simple to complex rules.

Biosurveillance represents the most complex and potentially critical application of critical event warnings, and is addressed separately, following.

Syndromic Surveillance

Clinical systems should deliver real-time data as needed to support local, regional, and national biosurveillance and public health needs. They should automate the reporting of reportable diseases and make it easy to add new diseases to that list of reportable entities. Clinical systems should also be capable of receiving and displaying alerts from public health authorities.[2]

EDIS systems should be able to monitor for both syndromic presentations and specific diagnoses. Severe acute respiratory syndrome (SARS) can present with flu-like symptoms, as can bioterrorist agents. A spike in the incidence of the influenza diagnosis should trigger an alert. Two or more cases of meningitis could trigger the appropriate Public Health response, as well as alert all practicing physicians, by e-mail, pager, or fax. Matching cases to postal codes can further delineate the source of an outbreak.

Additionally, an EDIS running automated daily searches for a small set of index markers (fever, cough, shortness of breath, diarrhea, rash, headache, O_2 sat $\leq$ 90%, etc.) should also automatically signal any spike above normal, when these occur. For an annotated bibliography on the subject, see http://www.cdc.gov/epo/dphsi/syndromic/analytic.htm.

Communication of the Electronic Medical Record

Electronic clinical records should be released immediately upon the certification of a clinician that there is an immediate clinical need for the release of those records. Clinical information systems should be capable of transmitting such records across a firewall by a variety of secure electronic means, including secure e-mail, secure FTP, and secure Web-based transfers. Systems should also support direct facsimile transmission and should be capable of tracking and auditing all such transfers.[2]

While only a small part of the overall EDIS, it is essential that primary care physicians should have access to their patients' records, and should receive some form of summary of all ED visits. Additionally, when qualified health care providers from other jurisdictions request access to part or all of the patient's medical records (i.e. to compare ECGs against previous recordings), then this should be done quickly and easily.

Research Support

Emergency department registration and information systems should facilitate the identification and enrollment of patients in ongoing research.[3]

Emergency Departments are not conducive to research. Patient flow is unpredictable; when patient volumes are highest (and most research subjects present themselves), physicians and nurses are most pressed for time. Providers may forget about research studies, or choose to ignore them.

Automated systems are ideally suited to recruiting patients, ensuring they meet enrollment criteria, and automatically logging much, if not all, of the data required. Web-based forms, on tablet PCs or handheld computers, can bring study data collection to the bed-side, and are as good as paper.[10] Complex diagnostic and/or treatment algorithms are easily triggered. One-click ordering can replace a ten-minute search for a paper protocol. Sampling bias can largely be eliminated, and to the degree that it occurs, quantitated.

Data Analysis

Emergency department administrators, clinicians, and researchers should be provided with a choice of visual and statistical tools with which to analyze their data and the training to use them effectively.[3]

A picture is worth a thousand words; single images can reduce enormous amounts of interrelated data to easily-appreciated relationships. Not only should an EDIS database be based on open standards and support easily-entered custom SQL queries, as discussed above, but the EDIS should either provide strong visual analytical tools, or integrate with them. Proof of specific support of/integration with data analysis tools such as SAS and Enterprise Miner by SAS Institute Inc., Clementine and SPSS MapInfo from SPSS Inc., Crystal Reports, and Oracle Data Mining, and the nature of that support/integration, should be provided by the EDIS vendor.

Fault Tolerance

Clinical systems should remain functional around the clock. If a system is designed in such a way that it must be taken offline for more than a few minutes during routine maintenance, equivalent data should be made available through some other system during that period.

Backup systems must be maintained, tested, and exercised regularly to ensure that patient care can continue during primary system outages. Testing and exercise of backup systems should be performed without turning off primary clinical information systems.[2]

Cost Considerations

Besides the actual cost of the EDIS (system and installation), the following costs should also be considered. Project managers will need to be hired, and dedicated local IT staff are required to build interfaces to the IS. Existing infrastructure may be used, or new infrastructure may need to be built: redundant servers with the appropriate networking topology; wired and wireless networking in the Emergency Department itself; bed-side clients, tracking boards, individual provider client solutions. The infrastructure itself will require ongoing maintenance.

On the EDIS software side, maintenance agreements, upgrades, etc. incur ongoing expenses.

Savings will be realized on multiple fronts. Paper medical records not need be pulled and hand-delivered, or maintained. Results will not be printed, and very little paper will be required for charting. Secretarial duties will be significantly lessened with auto-paging of consultants, respiratory or ECG technicians, the automation of physician orders, with automated chart coding, generation of consult requests, clinic appointments, etc. Hospital paging services could easily become fully automated – instantaneous and accurate.

Finally, *for system that works, i.e. actually improves nursing and physician processes*, expedited patient care via immediate notification when labs or other orders are either due, or returned, and instant access to results as these become available, will save lives. It will also decrease nursing and physician workload, which in turn could well result in hospital savings.

Recommendations

A number of commercial Emergency Department Information Systems products provide, in large part, the essentials required for our situation. Due to the enormous complexity of a fully-featured EDIS, "roll-your-own" systems are not recommend – unless one has far more money, time, and programmers than one knows what to do with. For the same reason, I cannot recommend that we wait for Eclipsys to release its product: it takes years and dozens of installs to develop all the required interfaces, to work out both minor and mission-critical "kinks" – and not all products are successful doing so.

Of the comprehensive EDIS solutions, Wellsoft Emergency Medicine Software, by Wellsoft Corporation, has been installed at several Canadian locations, the latest at North York (during the SARS outbreak, incidentally; the system was further customized to deal with this contingency). I would suggest we contact our counterparts at North York, for comments regarding their experiences. My largest concern with Wellsoft, and that for all other vendors, is the fluidity with which nursing and physician charting takes place, and whether nursing/physician processes are actually expedited. I would also suggest we contact Wellsoft for the names and total number of installations elsewhere, in Canada especially, and that we contact these references, prior to submitting a formal Request for Proposal.

Also potentially worth investigating are EDIS's from Cerner and NWS/EDS 5.0 from New Wave Software, Inc. Cerner's comprehensive EDIS, interfacing with the latest release of Cerner HIS (8.0 or better) appears solid, though charting does not appear as fluid as Wellsoft's. At a vendors-barred discussion, several users commented that "productivity has plummeted," and this product has been de-installed multiple times – these comments may not represent the average site's experience, and also reflect problems with Cerner's HIS version 7, but should nonetheless lead us to look very critically at their system.

New Wave's EDS appears quite robust and full-featured. Its web site is informative, and gives a very good beginner's overview of what an EDIS can and should provide; it also lists its customers on its web site – most EDIS vendors' sites do not. That said, and as for all products, ease-of-use, ease-of-charting, caregiver productivity and enhanced patient care are critical concerns that cannot be evaluated from the floor of a symposium, or from a web site. New Wave has no Canadian installations.

For specifics on other EDIS software products, see Appendix B. Overview of EDIS Solutions.

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