



## 2008 Davies Ambulatory Care Award Application

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Chief Medical Information Officer (CMIO)

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Providers:                      Cardiologists:                      79  
   Hospitalists:                      3  
   Physician assistants:              11  
   Nurse practitioners:              5  
   Nurses:                              17  
   Research nurses:                  6

Number of FTEs:                Medical assistants:                54  
   Echo/vascular techs:            17  
   Nuclear techs:                    14  
   Stress techs:                      11  
   Other Employees:                201

Office Sites:                    21  
Imaging centers:                13  
Freestanding Cath Lab:        1

Average yearly E&M patient encounters per provider: 2,710

EHR Implementation Team  
Mark F. Victor, MD, CEO  
Scott E. Hessen, MD, CMIO  
Richard Mercier, MD, CMIO  
Peter Jannelli, executive director  
John Lagomarsino, IT director  
Dutch Visscher, EHR support

We have no commercial/employment relationships with any vendor of our EHR system.

## **I. The Organization**

Cardiology Consultants of Philadelphia (CCP) is the second largest single specialty cardiology practice in the United States. Our practice has 21 office locations in the greater Philadelphia metropolitan area, extending over four counties in southeastern Pennsylvania. CCP specializes in providing comprehensive cardiology care. We have 13 imaging centers that provide nuclear imaging and stress testing capabilities. We have the only freestanding, privately owned cardiac catheterization laboratory in Pennsylvania. Our physicians are on staff at 22 hospitals, and we interface with three university health systems.

The mission of CCP is to improve the health status of our patients through the provision of the highest quality cardiovascular care, research, and education. Every employee is an important and valued member of the CCP team. Each member strives to achieve excellence and ensure a nurturing, efficient, and effective caring environment for our patients. CCP is affiliated with the Cardiovascular Institute of Philadelphia, an independent, non-profit community resource dedicated to advancing the science and practice of cardiovascular medicine.

Predominant payers in the southeastern Pennsylvania area include Independence Blue Cross, Aetna, Medicare, and an assortment of HMO-style Medicaid plans. CCP treats all patients with full effort and resource utilization as indicated by their condition, irrespective of their ability to pay for their care.

## **II. Management**

### Why an EHR?

Beginning in 2002, the CCP Board of Directors began discussing the idea of adopting an electronic health record (EHR). Expectations included an improvement in patient care, ability to participate in pay-for-performance, a marked reduction in filing and transcription costs, a reduction in malpractice exposure and costs, and an ability to analyze individual and group practice patterns. Sophisticated accounting software allowed us to understand our finances exceptionally well, yet we did not fundamentally understand how we practiced our core business of cardiology. Third party payers had long suggested quality variations between offices and physicians, yet we had no ability to understand or refute these allegations. Finally, it was clear that quality improvement initiatives were becoming the general trend in medicine, and would likely become mandated in the future. We expected that Information Technology (IT) costs would substantially increase, but the Board felt that savings in other areas would offset these costs.

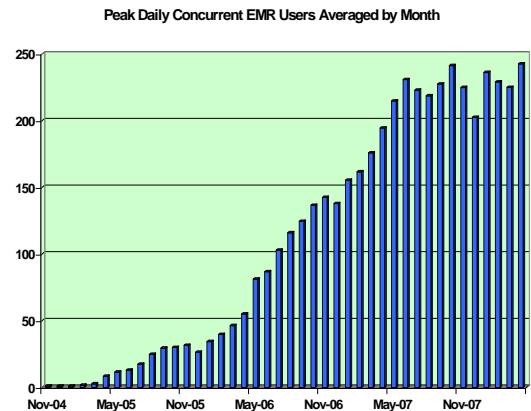
We anticipated that many costs could be reduced because of our EHR purchase. Before EHR, we spent approximately \$800,000 yearly on transcription. In addition, the cost of manually addressing envelopes and mailing letters to referring physicians was estimated at \$100,000 each year. We employed 20 filing clerks, with a combined salary and benefits expense of \$700,000 per year. Our yearly malpractice expense was about \$2,000,000.

Initially, the Board felt that the existing technology was not sufficiently mature to adopt, but eventually decided to invest in an EHR in 2004.



### Project Organization

We used a phased-in approach for deployment of our EHR system. Our office sites are geographically distant from each other and have a contained patient population at each site. This made it easy for each site to go-live separately from the rest of the practice. Since in-house personnel performed go-live training, the ability to take one new office live every several months did not overload limited training resources. Further, trained staff from established EHR sites could travel to offices going live to assist with their transition. We began EHR deployment May 2005 with three of 10 physicians in one office. We quickly realized that the clinical content was inadequate to support our cardiology practice. We then undertook a six-month project to develop our own fully customized content, during which time no further providers went live. After we were satisfied we had an acceptable product, we took new offices live at a rate of about one office each 4 to 8 weeks. As can be seen by the graph of averaged concurrent EHR users, we had a period of rapid linear EHR adoption beginning November 2005, which ended with our last office and provider going live May 2007.



Since our Board made the decision to adopt an EHR, and since each site had representatives serving on the Board, those representatives were responsible to explain and encourage other physicians to adopt the EHR system.

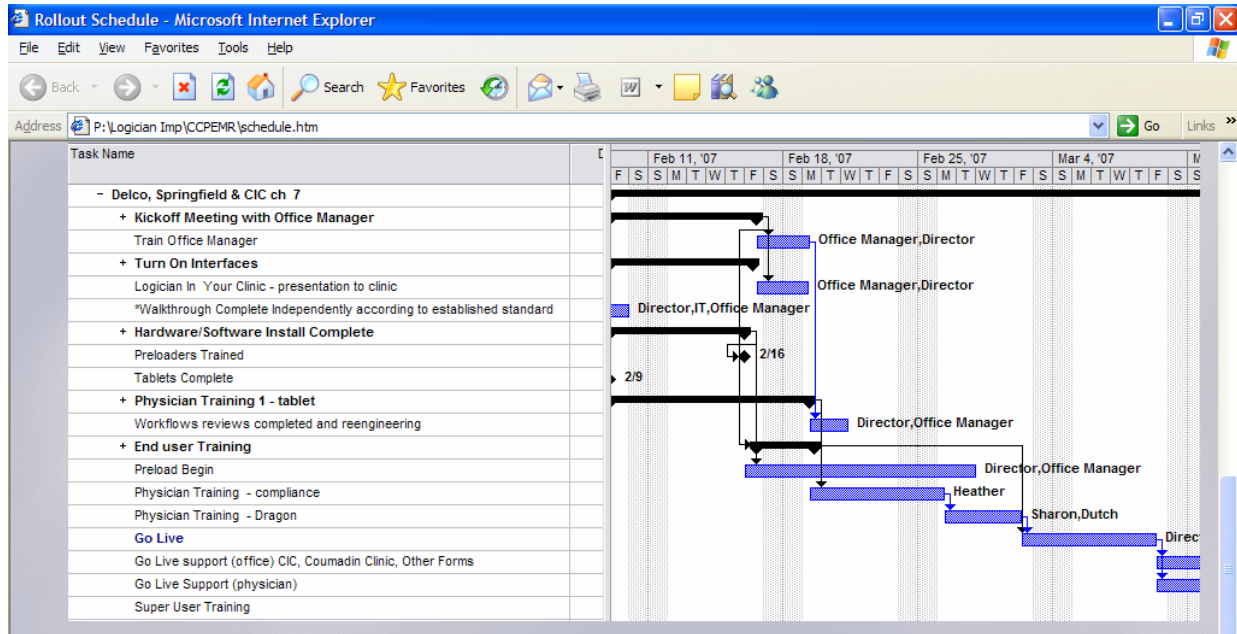
EHR deployment was guided by an EHR committee which was composed of several physicians, our executive director, the EHR project manager, and all IT and EHR related staff. We held weekly or biweekly meetings as needed. The EHR committee provided overall direction for the EHR project. Global questions such as workflows, needed changes to clinical content, or how much material from existing paper charts should be scanned and so forth were resolved at this committee level. The EHR project manager was responsible for the day-to-day decisions regarding EHR rollout, as well as the deployment of her staff, and the overall timing of the EHR rollout schedule. The physicians themselves determined the order with which offices transitioned to EHR.

General Electric (GE) staff participated in the go-live training of our first office. Since we decided not to use clinical content provided by GE, they were not involved in any further staff training or office go-lives. We continue to have support from GE for core software and hardware issues. IT support was obtained by hiring full time staff to develop our IT infrastructure as well as to implement EHR deployment. Current IT staff includes an IT director, a network specialist, and three individuals who are responsible for hardware and network support and maintenance, including staffing an IT help desk. A full-time interface programmer remains on staff since inception. We have recently hired a full-time database programmer as well. Three EHR support staff are employed full time and visit offices as needed for additional training, training of new employees, or other EHR and voice recognition related tasks.

Our IT department is responsible for maintenance of all servers, including backups, as well as maintenance of all hardware and network components.



We planned EHR rollout to occur at the rate of one office each 4 to 8 weeks. A complete schedule of rollout activities throughout the practice was maintained on the practice intranet using Microsoft Project. A typical office-training schedule is pictured below:



Several months before go-live, IT staff evaluated each office, placed wireless access points in patient care areas, and ensured robust coverage without areas of signal dropout. This required 2 to 5 access points for each office depending on office size. Other network issues such as printers, scanning stations and so forth were also placed and tested. Hundreds of PCs had to have software upgrades. All computers were updated to Windows XP professional; those that could not were replaced. Hospital and laboratory interfaces were built and enabled as appropriate. Typically, one trainer was responsible for physician training while another trainer had primary responsibility for staff training. Specific training in billing compliance was built into the schedule for physicians. Friday afternoon EHR pizza parties helped maintain excitement among the staff regarding the transition to EHR.

Each site knew well in advance when go-live would occur at that site. Physician office schedules were reduced, initially to 50% of pre-EHR levels, gradually increasing until pre-EHR levels were achieved within two to six weeks after physician go-live. Each office posted signs informing patients of our transition to an electronic medical record.

Initially, we scanned many existing patient documents into the EHR. This was both inefficient and costly. Subsequently, we minimized the amount of existing document scanning during subsequent office go-live. We gave our physicians the paper chart for three patient visits overlapping with EHR. Each physician would pull relevant documents from the paper chart to be scanned into EHR. After the third office visit, the paper chart was no longer utilized, but remained available if additional information was needed.

After we realized the inefficiency of an extensive preload of documents, we chose to extract clinical information from the paper charts. We populated problem lists, past medical history, social history,



family history, allergies and medications manually into the EHR. Qualified clinical personnel primarily performed this task prior to the initial EHR visit. At the time of the first EHR visit, the provider would review and edit this information.

As stated, at least two trainers were on site during and for several weeks after EHR go-live. The implementation team also included a select group of experienced users from sites already using EHR. These employees would sit for an entire day during the first week or two after go-live with the novice users and share their experience. This was a critical part of the training process and improved the comfort level of the new users. In addition, after an office had satisfactorily transitioned to EHR, trainers would double back to prior offices to answer questions and ensure that workflows were appropriately performed.

### Training

Basic Centricity® navigation training was conducted both in live groups by employee function and through WebEx sessions for general staff. We deployed an in-person hands-on strategy for training physicians and clinical providers. In order to simulate office visits, the physicians and clinical staff were given user accounts in Centricity® Network Training, a training and development environment otherwise identical to the production system. Users were encouraged to explore the Centricity® environment and to create mock patient encounters.

As sites went live, we identified “Super Users” which are users with above average computer skills that have also shown an aptitude in learning Centricity’s basic functions. These Super Users serve as a sounding board for questions arising when an EHR trainer was not on site.

EHR training was performed on-site at each office location. EHR trainers traveled between offices on a daily basis as needed. Provider training occurred in physician offices, while staff members were trained at their sites of work. Physicians were encouraged to preload some their own charts for those patients scheduled during week one of go-live. These preloads were completed in the Office Visit encounter form sets so that those forms were used by providers in a real clinical application before any patient was seen using EHR.

### Implementation

Our model for transition to EHR involved keeping paper charts available until the third EHR return visit of each patient. This dual active chart approach ensured that our providers had access to complete patient records, while minimizing the amount of scanning and data entry required during transition. Physicians were encouraged not to request documents be scanned into a patient chart until the third EHR visit, at which point most patients have almost a year of records in their electronic chart. Colored stickers placed on the paper chart after each visit allowed easy tracking of the number of times a patient had visited our office after EHR go-live. New external documents were scanned into the electronic chart and the original hardcopy shredded. We classified paper charts as closed to new information at go-live. At the third EHR visit, our providers chose which documents in the paper chart were invaluable; those documents were scanned into the electronic chart.

One of our largest successes has been our ability to develop an "unheard of" (according to GE) amount of customization in-house. All office encounters are completed using custom developed encounter forms. Actually completing our 21-office implementation within our scheduled timeline



is another point of pride. Our main mistake early in our implementation process was to allow some providers to “opt-out,” that is to delay their conversion into EHR. The confusion and breakdown of the perception of a unified goal make this option unwise at best and a source of work duplication and frustrating confusion at worst.

The limitations of using Voice Recognition software as a uniform dictation solution for such a large and diverse group of users were not apparent to us at the early stages of implementation. Although amazingly accurate for most users, speech recognition software can be prohibitively frustrating for some. Current speech recognition software has not advanced enough to accommodate users with strong accents, atypical speech patterns, or speakers with unusual tone, timber or cadence. In hindsight, a multi solution strategy for dictation would have been a preferred choice.

Our main challenge and an initially unsuccessful endeavor was to satisfactorily persuade resistant practitioners to adopt the concept of EHR as a preferable method for accomplishing their day-to-day tasks. Fortunately, this hesitation did start to evaporate as these users began using the system. When implementing a uniform system for a large number of users, inevitably the scale of perceived utility and value is correspondingly broad. However, as users began to adapt to the new system, their opinion tended to improve dramatically.

Microsoft Project was the tool of choice for scheduling our entire Centricity<sup>®</sup> project. In a practice of more than 20 sites and close to 500 employees, the task of an EHR implementation without advanced management tools would be untenable.

During implementation, weekly EHR meetings were open to all concerned individuals. EMR training staff relayed individual staff comments back to these meetings for discussion. All comments and ideas were aired, with consensus achieved by the end of most meetings. An intranet web site made available detailed minutes of these meetings and had a running summary of all decisions, as well as the overall project schedule. The CMIOs and Executive Director had final authority to make substantive EHR decisions, subject to approval of the CCP Board of Directors as needed.

Weekly EHR Operations Group meetings consisting of the Executive Director, EHR Project Director, Site Directors and EHR Analyst tracked the progress of the implementation plan and relayed concerns, accolades, new issues, suggestions, and complaints as the project plan evolved. The Executive Director then made periodic progress reports to the Board of Directors. As described earlier, each site has Super Users who can typically take care of most common questions. For equipment issues, there is a fully staffed IT helpdesk with mobile technicians. Additionally, our EHR Support team continually rotates from site to site to ensure that workflows are being followed, train new employees, audit compliance issues, and collect and report their findings to EHR Operations. EHR User Group weekly meetings including Office Managers, Super Users, and EHR Support serve as a sounding board for questions that arise which could not be addressed by our other protocols, or to disseminate solutions from site to site. In this way, we have ensured a premiere level of support on a continuing post-implementation basis.

#### IT Support

Prior to implementation of our EHR system, we had an inefficient computer network consisting of T1 lines between offices. We had one to two full-time IT staff to support this. In anticipation of



EHR and the increased data requirements associated with it, we installed leased fiber-optic lines between all offices and our data center. In addition our IT staff expanded to include a new IT director, a network management specialist, three support IT personnel, and interface programmer. Specific personnel for the EHR project included a newly hired EHR project director, as well as a full-time computer programmer (for custom content development), and a full time trainer. The team of the EHR project director, the IT director, our CMIOs, and our COO made technical decisions regarding EHR implementation.

As part of our EHR purchase, we purchased a Quovadx Cloverleaf interface engine. We hired a full-time interface programmer, whose job is to design, test and maintain specific interfaces between the EHR system and our practice management system and Holter system, as well as external interfaces with laboratory companies, hospitals, and implantable device manufacturers. With the above-mentioned staff in place, and with the assistance of General Electric, purchasing and installing required hardware was not difficult.

During our EHR rollout, weekly meetings were conducted to ensure a smooth set up, development, and rollout process. Meeting participants included relevant IT staff, as well as several lead physicians within the practice. Initial clinical content, was put together in a very basic fashion with the assistance of an external consultant. Subsequently all EHR clinical content has been developed in house, initially with a full-time programmer but for the past two years with an active cardiologist programmer. Our EHR vendor has not been involved in any aspect of our clinical content development or support.

In-house personnel handle all IT support, including EHR issues, as well as hardware difficulties. Hardware purchase costs have been deferred by utilizing an in-house leasing methodology.

#### Disaster Recovery

The data centers for our IT servers are maintained by CCP. Our EHR server is subject to real-time replication. In addition, nightly incremental backups are performed to a backup server located in a different building. Finally, a full backup is performed weekly to magnetic tape that is then stored at a distant site. Our practice management servers, and other servers, such as e-mail, Citrix, and so forth, are backed up nightly.

Fortunately, our backups have not yet been needed. IT staff perform a full restore yearly to ensure adequacy of backup.

### **III. Technology Purchasing: Vendor / System Selection**

#### EHR System

We chose General Electric's Centricity® EHR system. After our Board approved the concept of adopting an EHR system, a subcommittee of interested physicians explored various vendors' solutions. Ultimately, the General Electric (GE) and the GEMMS systems were considered. Members of the subcommittee viewed the various systems, and considered features. The enormous size and stability of GE weighed heavily in our decision to purchase their product. Simultaneously, we hired an IT director and an EHR project manager to coordinate the hardware and software purchases as well as rollout and training.



Our EHR solution utilizes central servers with dedicated fiber-optic communication lines to each office. Providers have their own tablet, either a Hewlett-Packard® tablet with keyboard, or a Motion Computing® tablet. Provider offices are equipped with desktop docking stations. Medical assistants and support staff have either conventional wireless laptop computers or desktop machines as appropriate. EHR software runs on each computer as a "fat client". Each office is wireless, utilizing WiFi 802.11a technology. (We quickly discovered that other wireless frequency bands were too congested to allow efficient use.) All network hardware is sourced from Cisco. Extensive use is made of voice recognition using Dragon Naturally Speaking®. Use of voice recognition, and especially voice activated EHR macros, required user tablets to run as fat clients and to have substantial local computing capabilities. The large capacity of our fiber-optic data lines has allowed easy adoption of a Cisco voice over internet protocol (VoIP) telephone system with little additional expense beyond the phones and servers themselves. The telephone solution includes integrated call center management between offices, as well has the ability to host in-house conference calls and Web-ex type computer functionality. It is fully integrated with our Microsoft active directory and enterprise email servers. Off-site and home access to our servers, including Centricity®, is available either by fat-client VPN or through a Citrix® farm.

#### IV. Functionality

##### Functionality utilized

Since we have created and maintain our own clinical content, programming, and encounter forms, we have the ability to develop unique solutions for cardiovascular clinical problems, and to do so in within a time frame commercial vendors cannot achieve. Several examples of solutions to common problems are presented below.

##### ***Decision Support / Real-Time Quality Improvement / Pay-for-Performance***

Our EHR system makes extensive use of real-time quality checking algorithms. This custom code evaluates each patient record during the course of his or her office encounter. Before the patient can be dismissed, deviations from defined quality measures are identified and presented to the provider. This gives the provider the opportunity either to correct the quality deficiency, or to provide an explanation for deviation. The EHR presents the evidence for the appropriate quality indicator. It is not possible for providers to bypass these quality checks. Furthermore, the output of this quality

The screenshot displays a clinical decision support tool. At the top, there are tabs for 'Impression', 'Patient Instructions', 'Letter Defn #1', 'Letter Defn #2', and 'Admin'. The main content area is titled 'This patient has evidence for Atrial fibrillation. Warfarin or aspirin (if low CHADS2 score) should be prescribed unless contraindicated.' Below this, an 'Evidence:' section contains a text box with the following text: 'ECG dated 02/25/2008 shows atrial fibrillation. The Atrial Fibrillation CHADS2 Score is 3. The predicted yearly risk of stroke without treatment is 5.9 %.' To the left of this evidence is a section titled 'Why or why not warfarin?' with a list of checkboxes: 'Patient is prescribed warfarin', 'Patient is prescribed aspirin', 'Patient is prescribed clopidogrel', 'Peptic ulcer disease', 'History of GI bleed with warfarin or aspirin', 'History of intracerebral hemorrhage', 'Intolerant to warfarin', 'Excessive fall risk for warfarin', 'Risk/benefit ratio unfavorable for warfarin use', 'Patient has LAA occluder device', 'Patient on Factor X inhibitor', 'Patient has lone atrial fibrillation', 'Patient refuses to take', and 'Other'. To the right of this list is a 'Comment:' text box. At the bottom of the interface, there is a dropdown menu for 'Review Data and Evidence for:' with 'AtrialFib' selected, a red 'Review' button, and a green 'Proceed to' button. A small explanatory note at the bottom reads: 'The CHADS2 score is used to predict the future risk of cerebrovascular events (strokes) in patients with atrial fibrillation. The score assesses CHF, hypertension, age > 75, diabetes, and prior stroke or TIA to predict yearly risk. CHADS2 scores > 1 usually warrants warfarin unless contraindicated.'





checking directly drives automated Medicare pay-for-performance submissions if appropriate for each patient. Examples of our cardiology quality indicators include anti-platelet therapy use for patients with coronary artery disease, beta-blocker therapy for patients with prior myocardial infarctions, ACE inhibitor or angiotensin receptor blocker use for patients with systolic congestive heart failure or left ventricular dysfunction, prophylactic ICD implantation in appropriate patients, smoking cessation advice, and warfarin utilization in patients with atrial fibrillation. As an example, the atrial fibrillation quality screen is reproduced. Clinical evidence is drawn from each patient's medication and problem list, ECG interpretation, latest ejection fraction, as well as from text searches of their past medical history. The EHR presents the provider with data as to why anticoagulation is indicated, including the patients predicted yearly stroke risk. The provider must explain the reason if warfarin is not chosen. If this patient is already on warfarin, this quality-check screen is not presented, but the data is logged for quality improvement purposes. Now that all CCP providers have been on EHR for more than one year, we have begun to collect aggregate quality data, grouped by provider, for use in internal quality improvement, and eventually for pay-for-performance contracts.

### Physician-specific Letter Definitions

We have discovered that 80 cardiologists have 80 different formats for the way they want their letters to referring physicians to appear. Further, each one of them is absolutely certain that his or her letter format is best. For example, many of our physicians are passionate about even simple things, such as if their referring physicians are addressed by their last or first name. We have dealt with this by creating custom code that allows each provider to define and maintain the structure and look of his or her

letter, including overall format, which specific paragraphs are included, and various personalization features. Each provider has his or her own potentially unique letter format for each practice site. Furthermore, each letter format is user customizable for a specific patient or a specific encounter as needed. The two screens providers use to customize their letter formats are reproduced. Notice

Impression | Patient Instructions | Letter Defn #1 | Letter Defn #2 | Admin

**Cardiology Letter Definition- part 1**

[Load my Default Letter Format](#) [Load Previous Letter Format](#) [Store as my Default Letter Format](#)

Applies only for site: **HUH** These settings override my default values for this patient?  Yes  No

**Greeting to Referring Doctor**

Opening Dr. Salutation:  Dear First name  Dear Last name  Dear Full name  <Special>  None

**Opening Sentence**

Opening Sentence:  Context appropriate  Provider defined  None

**Letter Sequence**

The items listed below define the sequence of paragraphs in the letter. Separate items with spaces.

HPI ROS SH FH PMH PE Meds Allergies Problems Impression

ECG Labs Device Echo Nuclear Notes

Sequence: HPI MEDS PROBLEMS ROS PE LABS<90 ECG Echo<180 Nuclear<365 DEVICE IMPRESSION [<Clear Sequence>](#)

**Overall Letter Format**

Format:  Text only  Headings with Text  Headings with Tabular info

Patient Name:  Formal  Informal

**Medications**

List before changes  List after changes

Include Instructions?  Yes  No

**Problems**

Problems:  Without ICD9 codes  With ICD9 codes

**Physical Exam**

Report height  Report weight  Report temp  Report resp

**ECG**

ECG:  Limited detail  All details

[Letter Definition - Go to Page 2](#) v 3.0.1-1-2008

the sequence of included paragraphs defined in the Letter Sequence section. The numbers associated with certain paragraphs, such as "LABS<90" ensure only recent data (in this case less than 90 days) are included. In addition, note the use of logical inserts such as <heshe> and <meus>



that are replaced with the word he or she and me or us as appropriate in the ending sentence definitions. Letters thus created do not appear electronically created. The use of voice recognition and dictation for History of Present Illness and Impression & Plan ensure that the letters have meaning and impact for referring physicians.

We have developed data import forms for imaging procedures

such as echocardiography, vascular ultrasound, nuclear imaging, stress testing, as well as Holter monitoring. Associated with these forms is intelligent report writing code that produces reports without the typical appearance of a computer-generated report. Data from these studies is tightly integrated with encounter forms during the patient's office visit, which helps to ensure optimal patient care.

### ***Remote ICD and Pacemaker Follow-up***

We have created custom interfaces with three manufactures of implantable cardiac devices (Boston Scientific Latitude, Medtronic Carelink, and the St. Jude Merin.NET systems). Device interrogation data from patients enrolled in remote defibrillator and pacemaker-monitoring systems is forwarded to our EHR using HL7 messages. These appear as laboratory reports in our EHR system. These messages use structured data and are imported into custom device management encounter forms. Similarly, we have integrated Medtronic's Paceart system to allow data collected by wireless enabled device programmers within our offices to be transmitted (via SessionSync) into our EHR system. Letters to referring physicians regarding the status of their patients' implanted device are generated using these interfaced sources of data.

We have custom data entry forms for use with warfarin monitoring, echocardiography, vascular studies, nuclear cardiology, Holter monitoring, and transtelephonic pacemaker follow-up. Procedural reports are created by extensively programmed routines, which produce output that referring physicians are comfortable with. We take great pains to avoid the appearance of computer generated letters or reports.

### **Functionality not implemented**

We have chosen not to implement the E&M advisor functionality included within Centricity<sup>®</sup> because of compliance concerns. Our Board felt that the potential for billing abuse by physicians



was too high. Our own code identifies and designates billing codes that are not supported by documentation, but it does not suggest a certain level of billing based on documentation.

Our physicians remain concerned regarding direct messaging with patients. For the time being, we have elected not to add that level of functionality.

Finally, some hospital interfaces are not selective in the type or amount of information provided. To avoid a deluge of information (all inpatient labs, all radiology reports, and so forth as distinct from outpatient labs or tests), some hospital interfaces have not been enabled.

## V. Value

### Success in Meeting Objectives

We have achieved significant savings in several areas due solely to EHR implementation. This past year, our transcription costs have been reduced to under \$100,000 from a pre-EHR cost of \$800,000--a reduction of 88%. Filing clerk positions have been cut in half for a \$350,000 savings. Similarly, we have received a 3.5% reduction in malpractice insurance expense representing a \$70,000 savings. CCP has been successful negotiating materially improved reimbursement rates with almost all of our payers, and we expect additional revenue because of our participation in Medicare pay-for-performance reporting.

We have had many clear improvements in clinical care due to our EHR. Several examples are presented below. Several years ago, CCP settled a lawsuit because an abnormal diagnostic study report had been filed in a patient's paper chart without being seen by his or her provider. Our current process of scanning all documents into EHR unsigned, and forwarding these documents to the provider's desktop for review and signature eliminates the possibility of clinical information bypassing a provider. Another example relates to tracking of patients on anticoagulant drugs. In the past, many of our offices relied on the patients themselves to return for repeat INR blood tests while they were receiving warfarin anticoagulation. There are 7,267 patients in our practice currently prescribed warfarin (that number would have been unknowable prior to EHR). Since we have created a customized encounter form for warfarin management, we have been able to run weekly reports indicating which patients are overdue for their blood tests. We have found patients overdue as much as 6 to 12 months through this process. Our nurses are now able to contact these individuals to facilitate their compliance with anticoagulation monitoring.

Provider satisfaction has been more of a mixed result for us. All of our physicians acknowledge that they have become better, more thorough doctors because of EHR. Some have been able to leave the office earlier, or increase their productivity. A few physicians continue to have difficulty, and find the EHR a burden. Several physicians have ongoing difficulty with voice recognition, which can be problematic during a busy office session. Other physicians who were used to having many office patients and their diagnostic studies performed concurrently as needed (the "whirlwind of chaos" office model) have had difficulty adapting to the more linear patient flow with EHR. Much of our trainers' time continues to be devoted to resolving these provider difficulties. We have constructed voice-activated shortcuts (macros) to improve efficiency. Generally, these perform well but sometimes fail, at which time the provider may be in worse trouble than if macros had not been



used. Providers often do not fully understand the steps or mouse clicks required to replicate the macros functionality, and thus become lost and frustrated.

Many of our patients have noticed improved information access and availability brought about by EHR. They often will tell us which of their other physicians are currently not using electronic records in their practices. It is clear that they notice the difference. Finally, some of our patients have now come to expect providers to have access to their medical information after hours and on weekends, something our EHR allows.

#### *Transformed Processes*

Staff members have always handled prescription renewal, with appropriate notation entered into the patients chart. The EHR allows increased productivity by eliminating the need to obtain the paper record to document the refill. Similarly, it is easy to determine if the patient has been seen recently or needs a follow-up visit in order to refill medications safely. There is no uncertainty regarding the actual medication or tablet strength when refills are requested.

With paper charts, patient messaging was cumbersome, slow, and had substantial risk for error. Patient communications were typically documented on paper phone message slips that were placed on the desk of the physician. Follow-up was rarely documented and the slips were easily lost, or not attached to the patient's permanent chart. With EHR, the process is efficient and errors have been dramatically reduced. Communications are immediately routed to the appropriate physician desktop attached to the patient's medical record. Responses are fully documented.

Implantable device (pacemaker and implantable defibrillator) follow-up has changed dramatically due to the integration of EHR and outpatient services such as Latitude, Carelink and Merlin.NET. These systems can detect and report on device abnormalities, patient arrhythmias and so forth on a daily basis. This information is monitored by our Arrhythmia Center, and when needed, imported electronically to EHR and forwarded to providers. The ability to have access to the complete medical record when interpreting implanted device data markedly facilitates and improves care.

Our most recent implanted device recall involved Medtronic's Fidelis defibrillator lead. By querying the EHR database, we were able to identify all of our patients implanted with this lead literally within 10 minutes after notification of the recall. In fact, we identified over 100 additional patients beyond those identified in the records of the device manufacturer. We created mail-merge form letters notifying all of these patients of the clinical issues and follow-up requirements in a matter of hours instead of weeks, as was required with previous recalls. We shared our experience with device manufacture's, which subsequently modified their local processes for collecting implanted lead data.

#### *Measures of Quality, Process Efficiency and Productivity*

Our compliance officer creates custom-made quarterly reports that evaluate provider compliance with billing requirements. These include issues such as having the correct number of items for a review of systems or physical examination to support the level of care billed. Providers who consistently demonstrate suboptimal compliance receive additional education. We electronically review charts for obsolete ICD9 diagnosis codes, and report on various indicators including the number of unsigned documents on a provider's desktop, completion of ordered studies, cancelled patient visits and so forth. Reports assessing provider compliance with medical quality indicators



(as discussed in section IV) have recently been created. Finally, our VoIP telephone system compiles statistics regarding the process and efficiency with which incoming calls are answered.

#### Improvement

We have continued to refine and reprogram our encounter forms and report formats. We are currently on our third major version of office encounter forms, with smaller additional changes already made (version 3.1). Similarly, we have rewritten our definable letter code as well as the code creating reports for echocardiography and nuclear cardiology. Our EHR diagnosis and billing forms have been modified to perform quality checking and to support pay for performance. We have upgraded to version 9 of Dragon Naturally Speaking, with improvement in the accuracy of voice recognition. We anticipate upgrading within the next 6 months to the 64-bit version of Centricity<sup>®</sup> along with a more powerful server to better support our users. We are investigating several different new tablet PCs, as our older tablet computers are approaching 3 years of age and are coming off warranty. Similarly, we are experimenting with solid-state hard drives to enhance PC performance.

#### External Networking

Interfaces exist for importation of laboratory data from Quest and LabCorp providers. In addition, we have interfaces for dictation, radiology, and lab reports with two health systems (Main Line Health and Crozer Keystone Health systems) and one independent hospital. Interface development with other hospitals and health systems are ongoing.

We were the first practice in the world to interface with the Boston Scientific Latitude remote implantable device follow-up system. Other remote device follow-up systems (Medtronic Carelink and St. Jude Medical Merlin.NET) are also integrated. We have developed integration with a Rozinn transtelephonic pacemaker follow-up system as well as a Rozinn digital Holter system. An Arrhythmia Center coordinates these activities within our practice.

#### Costs and Benefits Offsetting Costs

The purchase price of our EHR system, including the necessary infrastructure upgrades to our network and offices, was funded utilizing an internal leasing arrangement. No external sources of funds were provided for this project.

We have been able to negotiate materially better rates of payment for cardiology services with most of our insurers simply because of the presence of an EHR system. In addition, we have entered into pay-for-performance arrangements with several of our larger insurers, again increasing our reimbursement for clinical services. Both our custom programming of clinical content and the longitudinal patient data contained within our EHR have intrinsic value. We are currently discussing the possibility of contracts with several companies who desire access to this information.

## **VI. Lessons Learned / Critical Success Factors**

Because our EHR rollout occurred over a period of two years, there was a sense of competition among the different offices. The fact that one office was able to successfully convert to EHR increased the challenge for each subsequent office. In addition, as each office went live, we learned valuable new lessons along the way. After our first several go-live events, the process became



much more streamlined and efficient. Towards the end of our rollout, the process actually became easy.

With our first two office go-lives, we allowed physicians to delay their personal adoption of EHR. In hindsight, this was a disaster. It increased the workload and confusion for the rest of the office staff. Subsequent office go-lives were "turnkey" in that the entire office and everyone in each office went live at the same time without exception. This made for a much more efficient transition to EHR for all involved. After about one half of our practice was on EHR, our trainers doubled back to earlier offices and insured that any struggling providers received additional training. We did not enter this process expecting to develop our own software. Of necessity, we were forced in the early stages of our rollout process, to develop our own forms and clinical content. In hindsight, we should have done a better job of due diligence, observing the EHR system in actual use in a functioning cardiology practice.

Use of voice recognition with our current EHR product is valuable, but it is very complicated to use two non-integrated software products simultaneously. Voice recognition continues to be suboptimal for approximately 10% of our physicians.

We have learned that whenever possible, PCs should not be operated in an administrative mode. They are much more susceptible to viruses and staff can download inappropriate content with ease. Initially, our scanning solution would not run unless in an administrative mode. Despite being told by the manufacturer that it couldn't be done, our IT staff was able to create a "run-as" environment for this software to allow it to run correctly, without being in an administrative mode. This has reduced maintenance costs (for corrupted systems, viruses, and so forth) for these machines.

The expansion in the number of computers in our practice has increased the opportunities for staff wasting time (or performing inappropriate activities) on-line. Both of these problems have been well documented. Using a WebSense<sup>®</sup> server, we have adopted a policy that each staff member can freely access the internet for up to two 10 minute periods each day. Websites needed for appropriate work (such as pre-certification or medical information) are not restricted while sites promoting violence or sex are uniformly restricted by this server. A Barracuda<sup>®</sup> Anti-Spam Email filter and firewall limits most spam and internet viruses.

The most important aspect of EHR conversion is to observe the proposed system in actual clinical use. The prospective system should be observed in a practice as similar as possible to that of the EHR purchaser. The importance of adequate network and IT professional support cannot be overstated. Our IT infrastructure has become a mission-critical core business. Our IT staff is "on-call" 24 hours a day including weekends to support providers in our mission of providing excellent cardiovascular care.

## **Future Plans**

Presently, we are planning to move our data facility with our servers to a new location. We have outgrown both the power and air conditioning capabilities at our present site, and no longer can add additional functionality to our IT infrastructure. Our new locations will have a main server facility, and a geographically separate backup facility connected by a 10 gigabit/sec optical connection to



facilitate backups, database analysis and report generation. After this move is completed, we plan to enable an integrated fax server. In addition, a SharePoint® server has been purchased to facilitate communications and collaboration within the practice (creation of this document would have been easier if such collaboration software had been present).

Additional plans include investigation of a PACS solution for digital storage and manipulation of images. Our outpatient catheterization laboratory image server is currently being integrated into our network. Our nuclear cameras can share images and data among themselves, but are not yet integrated with EHR. Finally, our echocardiography machines all produce digital images, but these cannot be disseminated to the physician at different office settings. We anticipate that a PACS solution will accomplish all of these requirements. After PACS, we anticipate that a secured e-mail messaging solution, including patient messaging and e-prescribing, may be our next addition. As part of the messaging solution, we will move design and management of our practice web site in house.

At present, we have no plans to connect with a RHIO or disease registry. We are involved in pay-for-performance projects with Medicare as well as Independence Blue Cross and Aetna health plans, but with the exception of Medicare, reporting is not done electronically.

### **Summary**

The two chief medical information officers of CCP have each attended two out of the last three HIMSS meetings. Our EHR experience has been dissimilar to any experience we heard presented at those meetings. We did not set out to create our own EHR or to become software developers, yet that is how our journey has evolved. Because of our size, our practice was able to find or acquire resources that enabled us to create a unique, customized EHR system. We had some false starts and made mistakes along the way, but we always learned from these experiences. Our present system fits our practice nearly as well as could be imagined yet there are always new projects or modifications waiting to be coded, implemented or performed. Our ability to adapt and evolve our EHR system has been incredibly beneficial for us. Those who have examined our EHR, including other physicians and third party payers, have uniformly been impressed and enthusiastic.

