

The Organization

Virginia Women's Center is the largest women's healthcare private practice in central Virginia with 25 physicians and 12 mid-level providers at five clinical sites. Services have expanded beyond traditional obstetrics and gynecology to include female urology, pelvic reconstructive surgery, clinical research, psychological counseling, nutritional counseling and genetic counseling. Two Maternal Fetal Medicine physicians provide subspecialty care and manage five AIUM-accredited ultrasonography sites. The practice also offers digital screening mammography and bone densitometry. Our physicians are on staff at five area hospitals which represents three hospital systems.

Dating back to the late 1960s under the leadership of our two founding obstetricians, Virginia Women's Center's tradition has been excellence in patient care and service. Still today the physicians and staff at Virginia Women's Center are dedicated to the overall well-being of the women and families we serve. Our mission is to provide a lifetime of skilled and compassionate obstetrical and gynecologic care, to advance the practice of that care wherever possible and to offer convenient access to other services that complement that care. Practice decisions have always been strictly guided by the question, "What is best for the patient?" This commitment has served us well as we have navigated the many challenges facing medical practices in the 21st Century. We continue to raise the bar for ourselves in patient care, education and safety, customer service and workflow efficiencies.

Virginia Women's Center serves a diverse patient population reflective of the geographic locations of our practice sites. Our primary payors are Anthem, Aetna, United Healthcare, Cigna, Southern Health, Sentara, Medicare and Medicaid. Our practice participates in programs that provide care to the uninsured and underinsured in our communities. We are also actively involved with *Midwives for Haiti*, a global health initiative started by two of our providers. The program teaches Haitian women midwifery skills so they may provide prenatal care and serve as skilled birthing attendants in their communities.

Why Implement EHR?

Virginia Women's Center's leadership team began researching EHR in 1996. As dedicated as we were to excellence in patient care, quality and safety, we could no longer rationalize concerns over increasingly onerous chart documentation and chart access that came with our growth. We had addressed legibility in transcription but were still left with slow turnaround time, expense and limited access to the chart. Trends in obstetrics and gynecology litigation tipped the scale.

By instituting EHR, we estimated that we could reduce the number of FTEs per provider and transcription costs by \$300,000. Other advantages we anticipated included:

- Additional savings through efficiencies in workflow that would allow increased patient volume and reduced redundancy in paper handling.
- Enhanced revenue cycle management from improved coding, charge entry and billing.
- Access to utilization data for quality assurance and third-party payor negotiations, as well as database features to maximize success of our clinical research program.
- Improved patient satisfaction owing to simplified registration, flexibility in choice of office location and additional time spent with the provider.



- Greater job satisfaction among staff with easier access to charts, streamlined tasks and additional time available to be with the patient.
- Greater physician satisfaction, with improved patient safety and flexibility. The ability to complete office work from a remote site was a growing concern among physicians with young families, as well as the obstetrician-on-call who spends many hours in Labor and Delivery.

Our practice had experienced many years of successful operations. We were all in agreement that EHR would need to make dramatic changes to be worth the investment. Over seven years, we researched several products but could not find sufficient functionality. Marginal improvements would be insufficient. By 2003, the industry had begun adopting new solutions adequate to meet our needs. We narrowed the field to two finalists, engaged a consultant and issued formal requests-for-proposals. For reasons later outlined in the Technology section, Virginia Women's Center chose to proceed with GE's Centricity EMR.

Project Organization

Our long adherence to quality made it a given that the cost of a poor implementation would be far greater than software and hardware expenses. Given the enormous impact on workflow and the financial risk, we would not proceed without 100% physician buy-in. To bridge the gap between differences in attitude, as well as computer literacy skills, we instituted a phased approach, rather than the "big bang" approach. We felt further reassured that a sequential, gradual approach would better protect us against patient safety risks and negative financial effects.

We chose our smallest office for the initial implementation, in September 2005. One physician and her team began building the structure and customizing the best practices that would eventually function in the live environment and be expanded to our other offices. Over just 14 months, we would bring on board 35 providers in five locations.

We started with the basics: creating clinical content, such as forms and letters, and tracking mechanisms for lab and imaging studies. We established a training framework that would bring two providers at a site live at the same time starting in October 2005. Between each go-live, we made improvements in training techniques and continued to develop and customize content and workflows. We brought our last provider on board in December 2006.

From the beginning, we laid the groundwork for an enthusiastic and positive environment. Deliberately, we brought on the "nay sayer" physicians last, after implementation had been successful in other areas. Throughout the entire process, we encouraged our physician board members to promote EHR efforts consistently in their offices. EHR was a regular topic of discussion at monthly staff and provider meetings prior to our go-live dates. We also used the opportunity to further engage employees with exemplary performance and drive by giving them responsibilities for training in future go-lives.

As we shared progress, we generated excitement. Over and over again, we provided information and encouraged discussion among all staff to allay the expected fears of change. This approach also equipped physicians and staff to assuage any concerns of our patients.

The EHR training team consisted of the Clinical Applications Director, Operations Director and the Physician EHR Director. We also established an "EHR Helpdesk" for application support. Since it was comprised of clinical staff as



well as the mandatory Physician Champion, the EHR training team was highly patient-care oriented, and this also helped ease any evidence of transition that may have been apparent to the patient.

Our team appointments from within had another benefit: we were able to foster a “we are in this with you” attitude, rather than the air of a mandate from afar. The Physician EHR Director devoted 15% her clinical time to the implementation, while still continuing active practice. (She was compensated via stipend from the practice to perform these duties.) Two administrative staff members completed the EHR training team. The Clinical Applications Director had been promoted from a clinical position as a Medical Assistant and was dedicated fulltime to the project. The Operations Director was well versed in the scheduling, check in/out and business office processes, with 50% of her time allotted to training and development. For go-live training, we paired a trained physician with each new-to-the-system physician to keep the focus on patient care and developing the providers’ skills for maximum utility.

An EHR Committee, initiated prior to the initial go-live and most active during the 14-month implementation phase, was responsible for oversight and general guidance. It was comprised of the EHR training team, IT Director, Business Office Manager, physician representatives from the various offices and the Executive Committee, which includes two physicians and the Administrator. The EHR Committee met and reviewed developments on a weekly basis and as needed. We evaluated workflows, reviewed processes and developed forms.

Vendor support

For several months prior to the initial go-live, a GE trainer spent development and training time with the staff EHR Director. This pre-implementation phase involved some rudimentary form selection and introductory physician training with the system and voice recognition. During the initial September 2005 go-live at the small office, a GE trainer was onsite for four days; for two days at the second go-live. This GE trainer provided guidance on and clarification of system capabilities and was not directly responsible for implementation. Subsequent to the first two go-lives, he was not onsite but did provide weekly WebEx and phone support.

Additional vendor support came from a consultant with CCC, which was at that time an independent clinical content form building company. This consultant was onsite for the same two early go-lives. Additional voice recognition training was provided. We relied heavily upon her to assist us with form modifications and content development until our Clinical Applications Director gained sufficient form-building skills. Similar to the GE consultant, the CCC consultant continued to be available via weekly WebEx and phone support.

Specific Tools

We identified a goal from the beginning to establish universal standards and a Virginia Women’s Center best practices approach. To maintain consistency of documentation and content, especially in the multi-specialty nature of our practice, we used the same core set of forms for each encounter type.

We created text components to document common procedures, such as endometrial biopsy, IUD placement, etc., with macros to promote the ease of use and insertion into the office documentation. We encouraged quick texts and allowed them to be developed on a per provider basis. We created a global quick text inventory to improve uniformity and assist providers in many coding issues. We used forms to populate data fields with non-interfaced



lab, radiology and diagnostic results. Our insistence on consistency in the entered data per field ultimately enhanced reporting capabilities.

We created a robust “problem form” to give providers easy access to the diagnosis codes approved by the coding department. This minimized the utilization of reference list ICD-9 codes that could result in inappropriate coding. We standardized text translation descriptors to create a common language for patient problems. Ready modification of these descriptors was encouraged when appropriate to allow the provider to accurately and efficiently describe the individual patient’s assessment and plan.

We developed interfaces with the two major laboratories in the Richmond area, LabCorp of America and Quest Diagnostics. We established cross-reference files to eliminate the need for manual data entry for the majority of lab results. We interfaced Viewpoint¹, our ultrasound picture image archiving and communication system, and MagView², our mammography reporting system, so that reports would transfer in entirety to EHR. This also allowed population of pre-determined discrete data fields, such as birads category, impression, last menstrual period and gestational age. We were able to enhance clinical visualization and safety by designing specific disease-oriented flow sheets that allowed at-a-glance review of discrete data fields and helped to avoid the trap of “much electronic data, but difficult to see.”

Personnel

New roles developed that were not on the VWC organizational chart prior to EHR implementation.

The staff EHR director role developed into the Clinical Applications Directorship, with responsibility for interfaces, new form development, application support, content development and ongoing application training and retraining.

The Operations Director shares in the responsibility of application support, product development and continued integration and utilization of the system practice wide. This person focuses on the global and interconnected nature of all divisions within the practice. This also allows for redundancy in personnel responsible for the clinical functioning of the system, a hedge to protect the practice’s investment.

The physician EHR Director has evolved from being a temporary “tester” of clinical content to being responsible for continued functionality of the system, assisting in assessment of ROI for additional applications and development of enhanced patient safety and clinical decision support.

The Virginia Women’s Center IT Director had been hired in 2003 after a laborious implementation of the Practice Management system. Prior to the EHR, the IT team dealt primarily with hardware and software installation and support. GE Professional Services performed the actual initial installation of the EHR software, and subsequent maintenance is provided by the in-house IT team. The IT Director is the primary resource for EHR upgrades, server maintenance and software integration. The Network Administrator is responsible for hardware maintenance and IT support calls, which are on a separate support desk from the EHR help desk.

¹ ViewPoint Bildverarbeitung GmbH, Argelsrieder Feld 12, D82234 Wessling

² MagView Applied Software, Inc. Burtonsville, Maryland



Go Live

In planning our process, we identified key training points for physicians and staff. One point, and another advantage inherent to our phased-in approach, was our dedication to fully supporting each provider before, during and after the go-live. With this support, every provider was expected to function on a full schedule within two months.

Training sessions were held during staff and provider meetings prior to go-live. We used phone notes and receipt of labs via EHR to gain some familiarity with the new system prior to full implementation. Staff members practiced converting charts from paper to electronic with the preload process.

Furthermore, to ensure 100% provider participation, we installed full mobility and wireless access from every point in our five offices. We employed the HP TC-1100 tablet (rather than CPUs) to give providers, nurses and medical assistants full flexibility without compromising the patient experience. Tablet size, weight, wireless capability and ease of docking were all critical factors in preparing for the EHR. The individual training we conducted facilitated use of the system, particularly during go-live and the ongoing EHR help desk.

To avoid disruptions to patient care, the EHR training team provided maximum support onsite for two weeks. Prior to this time the staff was actively involved in the preload process. The EHR Committee had pre-determined which documents would be scanned in and what discrete data would be entered into the chart before the patient's first EHR visit. The paper chart was available for the first visit so the provider could review it and determine if any additional paper documents needed to be scanned. Providers were encouraged to "retire" the patient's paper chart after this initial EHR visit, although the paper chart would remain onsite for three years to permit emergency access.

To allow for adequate patient care during implementation, we eased providers' schedules for two months; by one-half of the usual availability for the first month and two-thirds for the second month. Providers were able to increase their patient-scheduled availability with their progress. Because of the phased-in approach, other providers in the same office could assist with the overflow of those providers in go-live. Thus, we could maintain per office volume and minimize any negative impact on patient care.

While the EHR training team was onsite, in the clinical care area, to be readily available to the provider going live, others could access them as needed via phone or email. We forwarded the EHR help desk line to the training team cell phones. The IT help desk was able to serve as a backup if volumes became excessive.

During go-live, physicians had the benefit of one-on-one physician training while actually seeing patients. Nurses and medical assistants benefited from the one-on-one presence of the EHR training team as well as the staff EHR trainers. The front desk staff was trained in a group, pre go-live to learn capabilities that interacted with EHR, such as patient pictures, document scanning and return-visit scheduling through electronic orders. The EHR training team worked with staff in medical records, mammography and ultrasound. Business office personnel were trained as a group on issues that pertained to their specific job function; for example how charge entry staff would capture appropriate data, based upon EHR documentation of hospital services.

Support was at the core of the training strategy. People learned at different rates. Those differences and various preferences were accommodated whenever possible. Providers and staff were able to choose their own equipment options. Some preferred docking stations, while others did not. This flexibility gave the user ownership of their set-up.



To transition to EHR, paper charts were preloaded prior to the patient being seen for the first EHR visit. Pre-determined documents, such as previous problem lists, last Pap, operative reports, pathology reports, last mammogram and previous prenatal records for those younger than age 40 were scanned into the system. Pre-determined discrete data fields were entered, including last Pap, mammogram and bone density results. Staff members were trained to enter past medical history from the paper chart. This process occurred a few days before the actual appointment, and we hired temporary workers, predominantly college students, to help accomplish this burdensome task. The providers had the paper charts available during the first EHR visits to ensure accuracy and completion of the paper to electronic conversion. Although order entry (Computerized Provider Order Entry) occurred from the first EHR visit, we used paper super bills until we could evaluate competency and get approval from the business office to stop the paper version.

The greatest success of implementation was a practice-wide improvement in quality and consistency of documentation and coding. No provider or staff opted out. By instituting EHR, we gained more uniform clinical workflows. We were able to audit these workflows, which would have been essentially impossible with paper charts. Our regular communications and dedication to problem-solving small issues led to enormous gains, such as laboratory tracking through order status and reporting of delinquencies. Every lab result was signed off on by a provider and double checked by nursing staff prior to completion of the tracking order. This eliminated the risk of filing test results before the physician had taken appropriate clinical action.

Implementation Lessons

One mistake of the implementation process was the use of patient-entered historical data via "bubble sheet" questionnaires completed during registration. This exercise slowed registration, causing massive delays in the providers' schedule. Additionally, the patient-entered data was often inaccurate and required more time to correct than when simply entered by trained medical assistants. We abandoned further development of the questionnaires, although not soon enough after the problem was identified. It was difficult to accept failure and financial burden of the unused technology. Knowing when to quit was a challenge.

Another mistake was the initial workflow developed for the preload process. We preloaded charts of patients seen in the past three years regardless of whether a future appointment had been scheduled. This meant that reports, labs and correspondence received following the preload required additional scanning. We adjusted the process to preload only charts of patients with appointments, and within two days of the appointment, to make the chart current when preloaded.

Because of the providers' previous comfort with dictation, we assumed that voice recognition would be the preferred data entry mechanism and purchased hardware and software to that end. Despite our training the providers, only a few were able to adapt to the new system. The time required to train the software to the users' voices was prohibitive for many. As EHR was implemented, it became clear that when providers utilized the developed tools correctly, very little keyboard entry was needed. Voice recognition became less important and was ultimately discarded.

The actual patient scheduling system determined the timetable for implementation. The EHR training team determined the order of offices and providers within offices. They kept the pace of go-lives consistent with two



weeks onsite per go-live and one week off in between to allow catch-up in development. Since the clinical schedules of the providers and trainers had to be reduced at least three months in advance, the combination of the three-week cycles and the patient scheduling system kept implementation on schedule. We calculated from the beginning that practice-wide adoption would take just over a year.

As we have noted, frequent and consistent in-office communications resulted in the broad and successful EHR participation. We continued to discuss EHR implementation, development and workflows at staff and provider meetings and encouraged all to discuss concerns. We made it known that we wanted to hear from everyone but that we wouldn't tolerate opposition to establishing EHR. We conducted focus groups of clinical and non-clinical staff to understand areas of concern and exchange of ideas. To engage staff members who were less enthusiastic about the project, we offered overtime to preload charts after hours. This established greater comfort with the system for them and thus eased anxiety and any negativity.

It was very difficult to have a formal assessment mechanism for the success of the implementation process. We monitored revenue generation and profitability of the overall practice and assessed the productivity of individual providers compared to previous years. We could only monitor satisfaction rates among staff and providers informally, and we did this with anecdotal communication. Once the go-live process had occurred and users were experienced, the informal mechanism of asking, "Would you go back to paper?" was routinely met with a resounding "No." At the time of implementation, resources were stretched too thin to perform formal patient satisfaction surveys. Surveys conducted in the early 1990s (on paper) and tabulated (by hand in Excel) demonstrated general satisfaction. We have recently adopted a method of electronic patient surveying and routinely get high marks for how the offices operate. Post implementation support is still ongoing but less and less frequent. The Clinical Applications Director and the Operations Director staff the EHR help desk while the IT team supports the IT help desk. The physician EHR Director remains available to providers via phone, email and EHR messaging flags for questions and concerns. Retraining and updates continue at monthly staff and provider meetings.

IT Responsibility

Although the Clinical Applications Director was primarily responsible for interface set-ups, implementation was a collaborative effort between her, the IT Director, GE interface technical support staff and the third-party interface vendor. The IT Director was responsible for purchasing the EHR hardware consistent with vendor specifications. Initially this was a Dell server which has since been replaced to accommodate changing processor and storage needs. A third-party vendor, Cisco³ was engaged to configure and secure a wireless network. As for the hardware purchased for the clinical areas, we quickly learned that durability is a major factor with tablet PCs. We abandoned the initial HP tablets for the much sturdier Panasonic Toughbook (models t7 and t8), equipped with Verizon wireless cards to allow universal access to the network regardless of nationwide location.

Virginia Women's Center realized early on that in-house IT staff provided a more focused energy to our specific EHR project. Consultants could be brought in for specific knowledge areas, but they would not serve the practice with the same passion as in-house experts. As noted earlier, the clinical content form-building consultant assisted with form modifications. However the Clinical Applications Director quickly gained proficiency for responding to

³ Cisco AeroSpace Wireless Network, Cisco Inc. San Jose, California



specific needs. One good example was the rapid in-house development of a Labor and Delivery documentation tool that allowed the obstetrician to fully record hospital events in both the hospital chart and the office EHR. The data accurately updated the past OB history, charge capture and notification of the clinical care area to allow timely telephone follow-up of the patient and new baby at home. The same in-house development created an EHR communication mechanism between the physicians in the hospital specifically providing the up-to-date status of hospitalized patients. This was invaluable for patient safety as well as communication with our business office. In general the EHR and IT teams joined together to ensure completion of responsibilities. The need for a formal evaluative process was not foreseen. As problems were identified, creative and collaborative resolutions followed. The EHR Committee reviewed the majority of these solutions.

Disaster Recovery

To address disaster recovery, the Oracle EHR database is mirrored using the replication software from the EHR (physical) server to the EHR backup (virtual) server on a continuous basis. Nightly backups of the database from the backup server are performed to limit production EHR server downtime. All tape backups include data verification and are taken off site and out of town. The EHR backup server is configured to take over in the case of a hardware failure of the production EHR server. The backup server is a virtual server, VM Ware⁴, which markedly limits susceptibility to hardware failure. The practice was run for two weeks from the back-up virtual server to assure the compatibility between the Oracle database software, EHR client software and the virtual server. The IT Director performs a full restore to test the EHR database backup. This was last performed in November 2008 when the backup server was brought online to test database replication. The backup server was then cloned to provide EHR test server for upgrade testing.

We learned that replication software can be safely used to provide an up-to-date copy of the production EHR database. By utilizing this software to back up the live database, tape backup can be accomplished without shutting down the production database. This is particularly critical in a specialty such as obstetrics that requires around-the-clock access to patient information. Overall, we learned that virtualization technology can be a valuable tool for implementation and testing of a Disaster Recovery Plan.

We defined protocols to give directions for patient care should the entire system or an application go off line. Preprinted paper templates mimic the EHR forms to ensure that visits are thoroughly documented on paper in a format that makes transfer back into EHR simple. We have placed at each clinical care area emergency red folders containing down-time items such as super bills, paper templates for visits and workflow directions.

Technology

In the previous section "Why Implement EHR," we described our objectives. Our search came down to two vendors. Our Executive Committee (two managing physician partners and the practice Administrator) along with the IT Director participated in extensive site visits to make the final decision between GE and DigiChart⁵. Three factors prompted us to select GE Centricity. One, the interoperability with the GE PM Practice Management system, which we already had in place. This assured us of the potential for interoperability with other lab, hospital and imaging

⁴ VM Ware Virtual Center, VM Ware, Inc. Palo Alto, California

⁵ DigiChart, Nashville, Tennessee

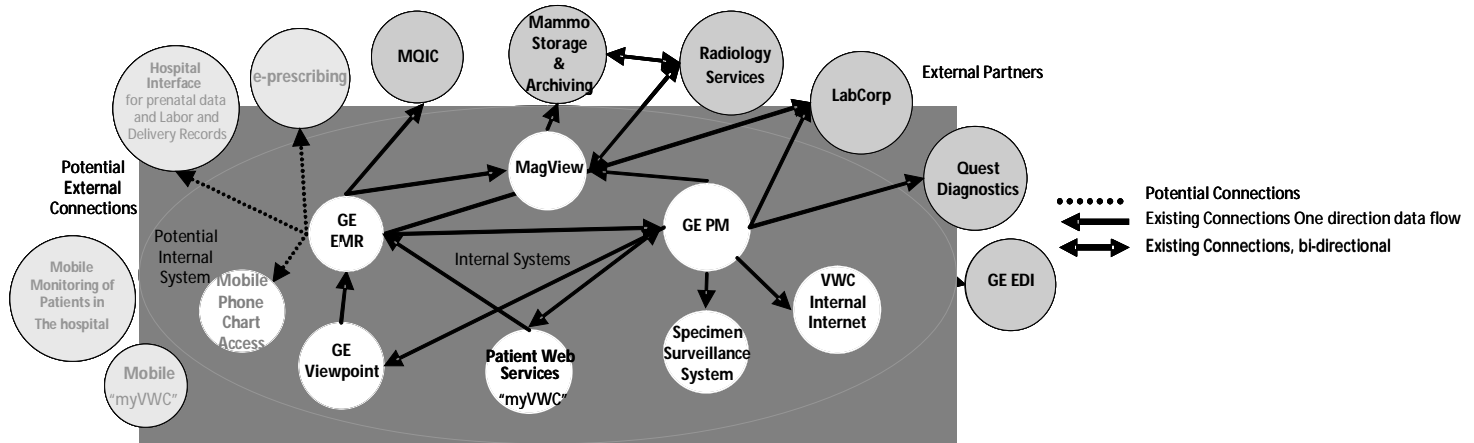


systems. Two, we were partial to a locally-managed product versus an internet-based one. DigiChart is an application service provider (ASP) model. And three, the financial stability and sustainability of GE was important and given their market capitalization, it was unlikely for them to be an acquisition target. Therefore, the physician shareholders granted unanimous approval to move forward.

The interfaces employed are all managed by the in-house IT staff, Clinical Applications Director and Operations Director. All clinical and business sites connect over a Cisco AeroSpace WPA-PSK³ secured wireless network. Biscom enterprise Fax⁶ software is directly integrated into the EHR system. External documents are incorporated into the system with the use of Docutrack Document Management⁷.

Assimilation with the ultrasound and mammography imaging occurs with the aid of third-party reporting software. Viewpoint is a fully-functional, picture-archiving communication system which allows provider visualization of the actual images and reporting directly into the EHR. We employ inbound and outbound interfaces with nine ultrasound machines and the Viewpoint software. Inbound interfaces exist from the GE PM system to Viewpoint, MagView and EHR. Both Viewpoint and MagView have outbound interfaces to the EHR. ScheduWare⁸ is interfaced with GE PM for appointment scheduling and bill payment, facilitating online patient access. The same software interfaces with EHR to allow online prescription refills. Laboratory interfaces with LabCorp and Quest deposit HL7 reports as previously noted. Physicians also have electronic access to one hospital system's radiology, laboratory and pathology database. As well, Virginia Women's Center participates in a RHIO, MedVirginia⁹ which is a repository for area facilities, in theory making patient data electronically accessible.

Interfaces



Functionality

Our Computerized Provider Order Entry capability is the most important functionality of the system in use. No paper super bill exists and providers generate all charges electronically at the time of service, employing the help of an

⁶ FaxCom CV+, Biscom, Inc. Chelmsford, Massachusetts
⁷ Docutrack Document Management, Formerly Kryptiq Corporation, Hillsboro, Oregon
⁸ ScheduWare, NexSched LLC. Marcellus, New York
⁹ MedVirginia Solution. Richmond, Virginia

E&M advisor form if necessary. This order entry process forces the provider to accurately indicate not only services rendered, but also labs ordered, imaging studies to be scheduled and follow-up visit and testing scheduling. The process still requires a scrubbing by business office personnel prior to electronic submission to third-party payors. But the efficiency has resulted in a reduction of charge entry personnel from 3 FTEs to 1.25 FTEs for office charges. This orders utilization also provides the clinical tracking system for labs and tissue pathology via an “in process” reporting workflow.

We have chosen not to submit charges electronically to the third-party payors directly from the provider’s entry because of the large margin for error. Charge entry staff can amend charges to reflect the payors’ individual idiosyncrasies to reduce denials and confusion on the explanation of benefits forms they return. Charge entry staff also serve as another quality assurance measure when providers omit critical charges in error, such as charging for a Pap smear but forgetting the office visit charge.

Value

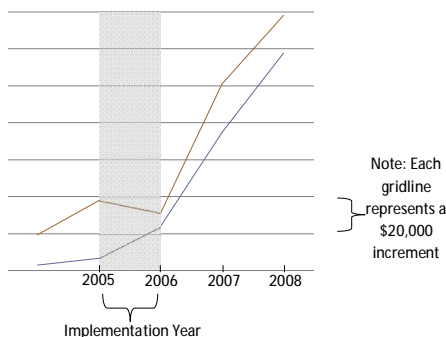
Virginia Women’s Center was anticipating and bracing for a 10-15% decrease in productivity as a consequence of implementation. The value proposition turned out to tell a story of fantastic return on investment for us.

When calculating ROI, it is impossible to separate direct EHR benefits and costs from the overall dynamics of a changing medical practice. For example, during the implementation phase and the year following, Virginia Women’s Center established new services including mammography and expanded counseling with an increase in the overall provider complement. We also revised our physician compensation plan. However, a broad global view of financial metrics shows much success. The implementation year resulted in level profitability without the anticipated 10% or greater decrease.

More notable is the marked profitability growth post implementation. Average profits per shareholder physician stayed level during implementation, and the year post implementation resulted in a 19% increase! Medical Group Management Association (MGMA) benchmarks ranks this level of profitability well above the 75th percentile.

The expected immediate \$300,000 elimination of transcription costs proved to be true. However the anticipated reduction in FTEs per provider did not occur. In fact the staff to provider ratio rose from 4.01 to 4.41 during the implementation year and fell to 4.33 the year post implementation. Virginia Women’s Center’s business model has always included a higher than average staffing complement to allow productivity and patient services that result in higher than average revenue production. In general, overhead has always been high to result in even greater top-line revenue production and ultimately higher bottom-line profits.

Average profits per physician and per shareholder



Workflow efficiencies and enhanced revenue cycle management contributed to this favorable profitability. The volume of patient throughput was increased. Pre EHR, the average number of annual patient visits per provider was 5,314. Post implementation,

it rose 11% to 5,629. The average number of annual relative value units (RVUs) per provider jumped over 13% with EHR.

Evaluation of the financial metrics as a comparison to revenue revealed a favorable decrease of operating costs as a percentage of revenue from 61% to 59%. As well, pre- and post-implementation staffing costs as a percentage of revenue fell an encouraging 29% to 26%. During this same timeframe, non-depreciable, non-staff, computer supply costs (support, licenses, consulting fees, minor hardware, etc.) rose from 0.6% of operating costs to 1.33%. As mentioned previously, charge entry personnel for office charges fell from 3 FTEs to 1.25 FTEs at the same time that pre- and post-implementation overall charges rose 29%.

In addition, clinical and patient care value propositions show improvement with the EHR system. The Computerized Provider Order Entry Process facilitating the reporting process clearly helped in identifying delinquencies in receipt and follow-up of test results. Previous paper logs were clearly more cumbersome and less accurate. Internal quality assurance reports allow monthly reporting of adherence to universal best practices, such as ante-partum compliance with genetic test offering, such as cystic fibrosis and nuchal translucency screening for chromosomal abnormalities. As well, time sensitive treatments in pregnancy such as Rhogam administration are monitored.

Patient care examples

1.) A very serious and time-sensitive issue arose after full implementation that Virginia Women's Center handled promptly and with far greater efficiency than any other practice in our region of the Commonwealth of Virginia. A lab vendor had a recall of reagents that resulted in our reference labs mandating a recall on Group B Streptococcal culture results. Pregnant women identified as having "negative" cultures at 36 weeks gestation would ordinarily not receive intrapartum antibiotic prophylaxis. However, with the recall of negative cultures, mothers may have inappropriately been excluded from prophylaxis, putting their babies at risk of early-onset neonatal sepsis, pneumonia, meningitis and possible death. The same day Virginia Women's Center was notified, we were able to identify the effected patients, notify them and the on-call physicians and establish a mechanism to provide repeat cultures. There is no doubt the EHR played a major role in accomplishing this timely, patient-safety "recall."

2.) Modern day obstetrical care identifies numerous medical conditions where anticoagulation is instituted for treatment and prophylaxis. As such, low molecular weight heparin (LMWH) is a somewhat common medication. At the same time, nutritional trends have markedly increased the ingestion of Omega 3 fatty acids in prescribed prenatal vitamins and over-the-counter dietary supplements. Some patients disclose use of these supplements to their providers, yet many do not. When the interaction of these dietary supplements was identified to have a dangerous interaction with the LMWH, Virginia Women's Center was able to identify all patients on anticoagulation and ensure that the patient and provider were aware of the importance of avoiding the Omega 3 fatty acids. The ability to quickly reach all affected patients clearly would not have been possible prior to the EHR.

3.) The EHR also has value for the Virginia Women's Center clinical research program. Patients who are willing to participate in studies are identified electronically and can be contacted when suitable studies are initiated. This is accomplished by data analysis of several factors including age, medications and diagnosis. Qualified patients gain access to high-quality health care at no financial cost while they contribute to evidence-based medicine. Enrollment can proceed in an efficient manner, and in fact Virginia Women's Center was one of only 12 U.S. testing sites for



patient accession for the recent HPV vaccine trials with Gardasil¹⁰. Virginia Women's Center has become a sought-after independent research site as the EHR allows unobtrusive recruitment from the large patient base.

Processes and perceptions

Transformed processes are most notable in the workflows. Prescription refills no longer require pulling a paper chart and faxing to the pharmacy along with obligatory documentation in the patient's chart. With patient access to online prescription refills, the process is even more streamlined. Electronic phone notes also avoid the previous paper chart pull. Compelling physicians to sign by hand all paper phone notes created by nursing staff was a challenge, and by default EHR mandates, providers are aware of all phone instructions and advice. This was a definitive improvement in liability and conformity to best practices.

Patient comments suggest that they feel their medical and private information is much more secure since the EHR implementation. Repeatedly, patients are indicating satisfaction with the decreased turnaround time for prescription refills, medical record transfer and notification of test results. We believe patients also appreciate and have more confidence in the speed and legibility of printed prescriptions. These results have influenced confidence, but we also acknowledge the hard work we did in regularly communicating with physicians and staff so they could pass their belief in the system on to patients.

It's a stretch to say that all physicians felt satisfied with the transition to EHR. The inherent transition stress of adopting EHR most likely prompted the earlier departure of a physician and a nurse practitioner approaching retirement. In general, younger physicians were easier to train and appeared to demonstrate greater approval. Despite varying levels of enthusiasm during implementation, the overwhelming majority of providers can complete their work more quickly and leave the office sooner. Remote access to the system from home or the hospital is a dramatic improvement for all providers and enhances their time away from the office. Physicians find on-call access to patient information and medication lists as well as ready access to past medical history major improvements over the paper record.

Ongoing Areas of Improvement

Secure electronic messaging with patients and fully-functional electronic prescribing are next steps to our ongoing patient satisfaction efforts. We also continue to develop mechanisms to allow patients online access to demographic and clinical data entry. We strive to be able to provide a patient with an electronic version of her medical record in an accurate, usable and meaningful form.

Prior to EHR, Virginia Women's Center had created a very effective and complete Pap smear and pathology tracking system. We have been able to maintain screening results, needed testing, test results, planned therapy and follow-up schedules thanks to an Access database system operating side-by-side with EHR. In the future we will integrate this fully with the EHR. The challenge is finding disease management software that will outperform the original functionality of the home-grown tracking system.

¹⁰ Gardasil Quadrivalent HPV vaccine, Merck, Inc. Whitehouse Station, New Jersey

External Networking

At this time and with the present payor mix, we do not participate in any significant pay-for-performance initiatives. We simply maintain patient safety and quality assurance as top priorities for development. We are members of GE's Medical Quality Improvement Consortium and are members of the Women's Health Best Practices Group working diligently on development of quality assurance indicators for obstetrics and gynecology. We are early members of Med Virginia which is a regional repository of data from area hospitals, laboratories and imaging facilities. Unfortunately this is a modified RHIO that brings data only adjacent to our system. Functionality issues and failure to have bidirectional automatic information flow have hampered full benefit from this relationship. In addition to the lab interfaces already functioning, an important interface with our major hospital is under development. This will result in bidirectional flow from our office charts with the hospital's Labor and Delivery EHR.

Virginia Women's Center has reviewed the financial benefits of adopting EHR. Yet predicting implementation expenses can be a daunting task, which is why it's often quoted as rationale for the low adoption rate in America's private medical practices. The initial direct EHR cost was almost \$800,000 (see Figure 1), which was booked as a capital asset. This was funded by debt over a seven-year term loan at 7.5% which was renegotiated in 2008 to 6.8%. As a realistic guide to the additional hardware and software costs past the principal EHR software, the itemized costs to Virginia Women's Center are listed below. A guiding principle for the practice in deciding which expenses to incur was answering the question, "Will the technology make it safer and more efficient to care for the patient?"

Figure 1

Item	Cost ea.	Quantity	Total
Centricity EMR Software	192,830	1	192,830
CCC Forms	46,140	1	46,140
CCC Training	21,600	1	21,600
Patient Link	27,700	1	27,700
DocuTrak Software	39,750	1	39,750
NexSched	2,455	12	29,460
BisCom Fax Software	5,000	1	5,000
Servers	2,200	2	4,400
Wireless Network	55,000	1	55,000
Cisco 3560 24 Port PoE Switches	5,250	5	26,250
Windows 2003 License-Servers	677	7	4,742
Windows 2003 License-Client access	28	200	5,644
Veritas Backup software	4,000	1	4,000
Tablet PC's	2,100	100	210,000
17 LCD monitors	244	180	43,852
Provision Networks Enterprise software	13,750	1	13,750
VM Ware software	5,000	5	25,000
VM Ware MGMT software	10,000	1	10,000
SanMelody software	19,641	1	19,641
Insurance Card scanners	225	17	3,825
PC's for front desk	550	10	5,500
Projector	1,485	1	1,485
			\$ 795,568



Critical Success Factors

The phased-in implementation was critical to the improvement in the process and the positive financial results, first. Workflows must be re-engineered to gain full benefit from an EHR. The second critical lesson is the necessity of due diligence prior to the EHR purchase. Even with adequate effort put into the information-gathering phase, any product or process will not always turn out as expected. We regularly experienced unanticipated road blocks but developed alternatives until the technology and engineering could catch up with the problem. Understanding that any system is an imperfect product will help dispel frustrations. The third and final lesson learned is that success relies upon the multi-factorial support of all involved stakeholders. For any practice wanting to succeed in EHR implementation, clinician involvement from the beginning is critical as is a physician champion with strong influence in the process. The foremost factor that allowed Virginia Women's Center to enjoy EHR success was a culture of commitment and engagement of the entire practice at all levels.