

# THE COMPUTERWORLD HONORS PROGRAM

## CASE STUDY

LOCATION:  
*Chapel Hill, North Carolina,  
United States*

YEAR:  
*2006*

STATUS:  
*Laureate*

CATEGORY:  
*Medicine*

NOMINATING COMPANY:  
*IBM Corporation*

### ORGANIZATION:

UNC Healthcare

### PROJECT NAME:

Web Clinical Information System (WebCIS)

### Summary

The University of North Carolina Health System (NCHS) has developed a comprehensive Electronic Health Record (EHR) named "WebCIS". The system employs some of the most recent technological advances in software development, including J2EE, HTML, and XML. The application runs on an array of Websphere application servers. WebCIS has replaced the paper chart for patient care within the hospitals and ambulatory care areas. While some EHR products tout their achievements, the reality is that less than 10% of physician practices use an electronic medical record. At our institution this system is used by 100% of the approximately 7000 caregivers to access and document patient care everyday. It serves as the medical record for almost 1 million outpatient and inpatient visits yearly.

### Introductory Overview

The main applications of the current UNC Health Care System EHR are as follows and are integrated through CCOW (Clinical Context Workgroup) technology into one application on the desktop:

**WeBCIS:** Our internally developed web-based Electronic Health Record application (in use and with ongoing development since 1991) has been extensively published in the literature and presented on multiple occasions at national forums. The application highlights include clinical ancillary result reports, inpatient and outpatient clinical documents with on-line direct entry clinical noting and electronic signature with referring physician automatic correspondence, problem lists, medications, allergies, healthcare maintenance and disease prevention decision support alerts, laboratory and radiology result alerts, and Outpatient Provider Order Entry for medications including direct electronic transmission of prescriptions to pharmacies.

**Inpatient Computerized Provider Order Entry (CPOE):** All inpatient units are "live" on Siemens Corp. "OAS Gold/Invision" computerized provider order entry. The importance to patient safety and clinical efficiency has been well documented in the medical literature. We have adapted the Siemens web enabled "OAS Gold/CVE" product to function within our multiple inpatient specialty areas (including all of our ICUs). To date, we have over 1500 specialty based



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order sets, which we feel are the key to adoption of CPOE by physicians. Standard drug/allergy, drug/drug interactions (with educational monographs), and minimum/maximum drug dosing alerts are all activated within the application. Preadmission orders allow orders to be placed in advance (for scheduled surgical procedures as an example), and then activated when the patient is admitted. The education of medical students cannot be ignored when a large institution installs CPOE. We developed and employ an “Unverified Order” status that allows for medical students to create orders that are then edited and electronically activated by house-staff officers or attending physicians.

Our outpatient CPOE module resides within “WebCIS” and is used in 100% of our ambulatory areas. The benefits of legible, coded prescriptions are probably the single most important patient safety benefit of CPOE. We are one of the first large institutions with a full-blown EHR to send electronic prescriptions directly to pharmacies. Under a contract with the “Surescripts Corp” which acts as an electronic clearinghouse, we are able to transmit prescriptions in real time to participating pharmacies within the state of North Carolina and nationally. This not only improves pharmaceutical safety, but also improves efficiency for the patients, as their prescriptions are usually waiting for them when they arrive at their local pharmacy. We have integrated the allergies and medications within our application, so at the time a prescription is written, using our scriptwriter or to electronically send a prescription to the area pharmacies, it will check the medications against allergies and alert the physicians about any potential allergies. We also are working on a SOA (Service Oriented Architecture) based link with a service provider to check duplicate drug, drug interaction, and dosage information.

**HEALTH MAINTENANCE/DISEASE PREVENTION:** Within “WebCIS” is a robust “engine” that provides point of care guidelines for both Health Maintenance and Disease Prevention. Both modules are specialty specific. For Health Maintenance, a template (from our information systems support group) is provided to each specialty at the institution. Each group can specify what tests, procedures (including immunizations), and historical data are required, based on patient demographics and desired time intervals. The application presents these reminders on demand. Likewise, a similar process occurs for Disease Management prompts. These prompts are based on coded problem lists, medications, tests and procedures rather than demographic information.

**DIRECT ENTERED NOTES:** WebCIS has a “Create Note” component that enables any user to customize the default content in a direct entered note. This helps physicians to document patient observations in a systematic, time efficient manner. Some of the redundant content also propagates between notes, thereby saving physicians valuable time. It also pulls medications, allergies and problems into the note. The main goal behind the noting function in WebCIS is to enter data only once in the system, and usable across the system thereby avoiding redundant data entry that is very common, in a healthcare setting.

**ANCILLARY RESULTS/INPATIENT EVENT ALERTS:** Through interfaces to laboratory, pathology, radiology, and Siemens ADT events, our physicians receive electronic alerts within WebCIS (for patients who have outpatient status) when ancillary results are finalized, their patients are admitted or expire on inpatient units, and other clinical care messages. Each message is linked directly with the result or patient event. Additionally, we have developed a robust electronic “phone message” module that allows for an iterative record of patient contact by phone calls. These electronic threads for a given episode of phone contact are permanently stored in the electronic record. We have purchased and are installing a commercial secure patient EMAIL



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system similar to this phone message module. This EMAIL application allows encrypted secure communications between care givers and patients, and the entire interaction can be stored in the permanent EHR.

**AGFA Picture Archiving Clinical System (PACS):** The entire Health Care System has been “film less” for radiographs and other image based technology for the last several years through use of AGFA PACS system. Both the text based reports and the images themselves are integrated within the WebCIS application. When a physician is looking at a radiology report in WebCIS, they are able to click a link that launches a viewer that brings the appropriate radiology image and video clips of CT or MRI, which corresponds to the report being displayed.

**T SYSTEMS ED RECORD:** Full computerized ED record including triage, other nursing, physician and trainee notes: integrated to WEBCIS

**“FEEDER” SYSTEMS TO WEBCIS INCLUDE:** Siemens Envision ADT, registration, and scheduling, laboratory, radiology, cardiac graphics and procedures, pulmonary laboratory, neurophysiology laboratory, vascular procedures, all dictation/transcription services, respiratory therapy, OR scheduling and services, and multiple departmental systems such as radiation oncology and transplant services.

### Benefits

**Inpatient CPOE:** The benefits of inpatient CPOE have been well described in the literature and our experience has mirrored other large institutions. We have achieved marked improvements in turn around time and patient throughput, particularly for cardiac procedures, radiological procedures and laboratory results. Times from order to floor arrival of pharmaceuticals has decreased by a factor of five. Though initially medication variances increased with the institution of CPOE (this has been well documented to occur with initial installation of CPOE), variances have trended downward during the second year after initial implementation.

**Outpatient CPOE:** Physicians and patients have, on opinion polls, reported increased satisfaction with outpatient prescribing accuracy, decreased pharmacy “call backs” for prescription interpretation, and clinical efficiency during the visit. Regulatory agencies have been pleased with the availability of coded medication lists, discontinuation of prohibited abbreviations, and legibility of prescriptions generated by the system. The electronic transfer of medication lists to online clinical documents such as inpatient History and Physical has resulted in decreased time and increased efficiency of clinical noting. Though we are early in our experience of direct transmission of outpatient prescriptions to pharmacies, patients are very satisfied that they have saved time and effort as prescriptions have usually been filled and are waiting for them by the time they present to the outside pharmacy. Coded medication lists tied to coded problem lists have allowed for the generation of disease management decision support prompts described previously.

**Alerts:** The immediate benefit from electronic alerts and messages to providers has been the elimination of paper based daily lists of ancillary results that have been employed for years in many departments and divisions at the institution. The “phone messaging” module within the system has resulted in improved patient care, as phone call based patient care decisions were either not documented at all, or documented on a “sticky note” that was either disposed of, or sent to medical records and “pasted” into the paper chart.



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**Electronic Signature/Referring Provider Communication:** We electronically communicate thirty-five thousand documents monthly (more detail described below) to referring providers, internally and within North Carolina and surrounding states. This process has eliminated the manual process of photocopying, envelope stuffing, and “snail mail” used previously to communicate with our referral base. It has increased dramatically the speed with which crucial patient care information is communicated to the patients’ primary care physician or specialty physician.

### The Importance of Technology

In the spring of 1999 UNC Hospitals found itself in an increasingly untenable position with respect to its’ Clinical Information System (CIS). Begun in the early 1990’s, the CIS had grown from a pilot project to a full blown production application serving the medical record needs of a large medical care provider community. By 1999, however, significant shortcomings in basic system implementation were becoming unacceptable. The problems included an underlying programming language that was not evolving with other computer technologies, difficulty in finding personnel with the requisite technical skills, and a lack of engineered redundancy capable of supporting continuous operations. To address these issues, the decision was made to rewrite the CIS using a World Wide Web based architecture implemented with Java and HTML technologies. This decision was formalized with a contract between UNC Hospitals and IBM in the summer of 2000 to create our third generation product, WebCIS. WebCIS 1.0 would replicate the functions of the CIS, but would do so within the context of web based technologies. In addition, the internal software team responsible for CIS development, retrained in Java and HTML as well as advanced application architectures, would participate with the IBM developers to insure that UNC Hospitals maintained the ability to repair and adapt the WebCIS code base in support of future functional needs. By the spring of 2001 the project was moving at full speed, and WebCIS 1.0 began alpha testing in December. From an integrated patient information display portal in 2001, we have evolved into a 4th generation comprehensive clinical information system, with point of care clinical decision support in 2006, with a long list of additional functions, such as custom, flow sheets, charting, and graphing capabilities.

On the Security access side, we have an LDAP (Lightweight Directory Access Protocol) that has the ability to control access to a functional level, so that we were able to support a wide array of users with their patient data needs, from the front desk clerk, medical students, and nurses all the way to residents and physicians.

On the infrastructure side, we have WebCIS running on two instances on an IBM mainframe, and 6 instances on Microsoft blade servers, with sprayers load balancing across those instances. This gives us the ability to support our current load and future growth, with acceptable sub-second response time.

Through a single sign-on and CCOW architecture, we are able to synchronize users, patients and encounters across our WebCIS and CPOE (Siemens) that eliminates multiple sign-ons, and reduces errors since the patients are synchronized across both.

Since WebCIS is an ultra thin client application that runs on Internet explorer with no client running, it is accessible on the floors on wireless PCs and tablets, and also across the globe from any internet connected PCs using a secure encrypted protocol. This helps physicians to access their patient records from any part of the globe.



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### Originality

The UNC EHR is one of the only electronic medical records that is used in both inpatient and outpatient settings. Most large medical institutions that have EHRs have one product used in ambulatory care and another application used in the hospital setting. In many cases, these disparate applications do not communicate data between each other. The UNC EHR is also one of the few “native” WEB electronic medical records that has actually been in real live use, and not in “development”.

As an academic institution, we have post graduate trainees that require medical faculty attestations of their clinical documentation. To this end, we have a unique workflow of electronic routing of online created clinical notes and dictated/transcribed clinical notes that allows for faculty electronic signoff of the trainee note, and electronic routing of these documents to 10,000 state wide private referring and primary care physicians that are not affiliated medical faculty.

The native WEB technologies used within the application allow for direct linkage to other native WEB applications both within and outside of the institution, thus providing educational links directly from clinical documentation areas of the EHR. As an example, a physician can electronically prescribe a medication for a patient directly to a pharmacy, have drug interactions checked against other drugs the patient is taking; obtain pertinent literature on such interactions, and print information for the patient regarding the drug being prescribed, all with just several mouse clicks.

Our dictation/transcription/electronic signature process is also unique. A physician (trainee or faculty) dictates via telephone to a local server that uses voice recognition to create the initial note. This voice recognition engine “learns” from each user over time, therefore improving the accuracy and decreasing our cost per line. The voice recognized output is sent either to transcriptionists for corrections and then sent back to the EHR for electronic signoff by the caregiver. This whole process occurs within 20-30 minutes. A patient therefore can be seen by a “specialist” who dictates a note immediately after the encounter, signs it within 30 minutes and the referring provider gets the report electronically immediately after signature. This process results in expedited patient care and referring provider satisfaction with our institution.

### Success

The success of the UNC EHR is illustrated by the impact our electronic medical record has had on patient safety and clinical efficiency, much of which is alluded to above. Some specific scenarios help to illustrate the success of the project.

Before the EHR was available a patient being initially treated in the Emergency Department began their interaction with care providers from “scratch” until a paper chart was ordered and available. At best, the chart would arrive within 10-20 minutes and approximately 15-20% of the time, the chart could not be located. With the EHR, the physicians and nurses have immediate access to patients’ coded medication, problems, and allergies; their Health Maintenance status, previous medical device images, and all text based reports of previous treatments. Now, after briefly checking the patient’s clinical status, the first thing our providers do is go to the computer to peruse their medical record.



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Previous to the EHR “on call” providers receiving patient or other physician calls while at home or out of the hospital setting would have no access to the patient record and would have to “fly by the seat of their pants” and try to glean as much historical information as possible from the interaction on the phone, i.e. “Doctor I am taking a blue pill and a green pill that is new and I am sick now”. The availability of the EHR securely through the web (on any device including PDA’s and “smart phones”) has resulted in life saving interactions that would not have been possible the electronic medical access. Some recent correspondence from some of our senior physicians:

“I had the chance to use many of the new noting features of Webcis while I attended on the geriatric inpatient service recently. You both, along with all of your associates, deserve special thanks from the clinician group for developing a system that I have found to be very helpful in the daily care of patients. It is both user friendly and “patient friendly.” The ability to input, retrieve, and disseminate information is truly remarkable. I know that problems will continue to develop and that much new will continue to be done in the future; however, what we have now is a major step forward. Thanks for all your efforts. Please thank others in your working group for me.”

”Thanks for the newsletter. I have generally been very happy with it (WebCIS). In particular I like the ability to keep meds online and write prescriptions and to be able to communicate easily with colleagues about patients. I believe it has improved our practice.”

“I have been using the system since close to its inception and find it a great boon for patient care. I have it on my computer at home and routinely the night before surgery I use my regular Internet service provider to check on a host of clinical data which previously required a number of separate and time-consuming phone calls to collect. The CIS is truly a wonderful piece of work.”

### Difficulty

Physicians and other caregivers readily accept the parts of an EHR that allow for rapid viewing of lab and other numeric results, images, and text based data. However, the major challenge for all developers of electronic medical records is the interfaces, response time, and facilitators that allow for entry of accurate and preferable coded data into an EHR by the caregivers themselves at the time of service. Early on in our process, we made the decision that the areas of the application that required user initiated direct entry of data would NOT be mandatory for clinical operations (other than CPOE which must be an all or nothing affair for patient safety).

Our results have been mixed. Some direct entry areas such as medications, consultation notes, daily inpatient progress notes, and phone messaging have been popular and used heavily, while other areas such as problem lists and health maintenance entries have not fared as well. The reasons for this are complex, but the result is that not all patients have complete data associated with their electronic record. This influences both clinical care and global data reporting from the system. We have learned that clinical care providers will spend extra time entering data, if they feel that they will gain either efficiency in another area of care as a result, or that patient safety is dramatically improved. However, if all we accomplish by direct data entry, particularly by physicians, is having the data viewable electronically, we have created exorbitantly paid data entry clerks. However, with over 10,000 registered users, 1000 concurrent users during the



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peak time, over a million-page look-up and over 1500 notes written per day, we feel that our efforts are paying off.

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