
Serving Physician Information Needs: A Model for the Transition to an Electronic Medical Record

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The requirements of a rapidly changing, competitive marketplace have amplified an existing demand for improved clinical information within the health-care organization, and focused increasing attention on the expansion of ambulatory care services, especially primary care. At the Queens Health Network (QHN), the consolidation of operations and regionalization of services compels the sharing of patient data throughout a multi-hospital system. Quality care for patients across a variety of settings, whose locus is no longer the inpatient hospital, requires the ever more rapid retrieval of longitudinal, integrated patient information at the point of service.

In the spring of 1996, implementation of a computerized electronic medical record (EMR) was proposed by senior administration to the medical staff as an integral component of QHN strategic and business plans. The decision was made to implement the software choice of the New York City Health and Hospitals Corporation (NYCHHC), Ulicare, by Per Se Technologies (formerly Health Data Sciences).

The Queens Health Network

A member of NYCHHC and an affiliate of the Mount Sinai School of Medicine, the Queens Health Network is the major healthcare provider in the borough of Queens, New York City. Serving an area of two million people, QHN is comprised of Elmhurst Hospital Center, Queens Hospital Center, eight freestanding medical clinics and six school-based health centers. Elmhurst and Queens are teaching hospitals, with rotating residents supervised by attending physicians with faculty appointments. Together, they provide more than 750,000 ambulatory care visits each year. QHN also provides home health care, and has contracts with three hospice organizations whose services include palliative care at Elmhurst.

Goals of the Healthcare Information System (HIS)

Project objectives, shared by medical staff and administration, include: 1) to facilitate and improve the documentation of clinical data throughout the lifetime of the patient, and across the continuum of care; 2) to support the improved quality of patient care through access to and availability of patient information; and 3) to integrate clinical information available from various legacy systems.

Project Planning and Leadership

Initial efforts were launched at Elmhurst Hospital Center (EHC). A project implementation team was recruited from within the organization, and an ambitious timetable outlined. A senior administrator, responsible for the provision of clinical services in the inpatient hospital, the operating rooms, and the emergency department, was relieved of those duties and designated as the project manager. A strategic management expert, she possessed the skill sets that would allow her to effectively negotiate competing priorities, and direct the implementation process. The project manager was partnered with a data analyst expert in outpatient operations, who assumed the title and responsibilities of technical director. Other project team members included the chief information officer, IS analysts responsible for the existing lab and registration systems, the radiology system administrator, and IS technical and communications experts. The team immediately assumed high visibility in the organization, as the project was given priority status and support.

The HIS steering committee, composed of senior clinical and administrative leadership, was created to institutionalize the project, and establish clinical and operational priorities. This group includes the medical directors of each primary care service, as well as key specialty care services and the emergency department; the associate dean of the medical school; the nursing executive; the chief operating officer of EHC and the senior network vice president of QHN; the directors of quality assurance and health information management; and administrators responsible for the clinical and ancillary services in ambulatory care.

The HIS development committee, composed of senior administrators, was commissioned to research issues prior to consideration by the steering committee, and keep implementation on track. Both groups are chaired by the HIS project manager and meet regularly.

To commence the project, every clinical and administrative department in the hospital was given a brief demonstration of the project and informed of its goals and objectives. In August 1996, the HIS design team was established, and a hospitalwide information session, with participation by all

department heads, was presented by the project team to introduce and encourage support for the endeavor. Members of the design team were (and continue to be) recruited based on their ability to provide clinical or systems expertise and to participate in the development of applications specific to their service or department.

System Implementation

Because the success of the project was deemed to be time critical, various application modules are being implemented in phases, in a continuous cycle of design and development. This approach is in lieu of “building the perfect beast,” which would require the commitment of significant resources over a number of years before providing any value for patient care activities.

The execution of an aggressive project timeline necessitated the compression of numerous complex tasks into a series of parallel, concurrent phases, all of which were completed within six months. These initial phases included the following activities.

- Creation of a physical infrastructure
 - Identify, design and renovate space
 - Design and build training center
 - Relocate project team
- Creation of a data communication infrastructure
 - Design and build a local area network
 - Design and build a wide area network
 - Plan and install hardware
- Clinical work flow analysis, including process redesign
- Software customization
- Project team training
- Development of system documentation
- Development of training program and documentation
- Implementation of provider training program
- Transition plan development and implementation
- Establishment of a help desk
- Software implementation and support

A hospitalwide data infrastructure, including Level 5 communication network, FDDI ring technology, mainframe computers, and terminal servers, was installed during the fall. More than four hundred personal computers and two hundred and fifty laser printers were located in exam rooms throughout the EHC onsite clinics in December 1996. Five hundred physicians and midlevel providers, nursing staff, and support and administrative personnel were trained during this month.

Implementation of the EMR was initiated in ambulatory care in January 1997, with the development of interfaces to the existing electronic registration (ADT), laboratory, and radiology systems. The immediate effect was to integrate and allow the retrieval of clinical test results by the physicians at their desktops. Physicians also began placing test orders on the system, and documenting problems on the patient problem list.

Project Phasing: Point-of-Service Computing

The HIS was conceived as a way of providing essential patient information to physicians throughout a high-volume, geographically dispersed service delivery area. Doctors were frequently unable to obtain timely patient information; and once they did, documentation of care might be illegible or incomplete. Tracking and providing the paper medical record to scores of primary and specialty care services, not to mention the emergency department and inpatient units, was a logistical ordeal.

The goal of the initial software implementation was to gain the support of the medical staff by resolving the most glaring issues for doctors. For the first year of the project, attending physicians, as well as residents and midlevel providers directly supervised by attending physicians, were the only users of the system, with other staff trained solely in a support capacity to the physicians.

Clinical documentation required by payers and regulatory authorities was arduous and time-consuming. For example, a physician is required to note the patient's diagnosis three times: once in the physician's progress note; a second time on the summary for patients receiving continuing ambulatory care services, required by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO); and again on the billing form. Physicians under pressure to see a high volume of patients were loath to duplicate efforts for reasons seen as bureaucratic and of little value to patient care.

The project team customized the electronic patient problem list to automatically capture appropriate ICD-9 and CPT-4 codes as the physicians document the patient's problem and the care provided at each clinic visit. In a single automated process, the documentation of diagnoses and procedures is completed, and physician and hospital billing is enhanced. The linking of financial to clinical documentation not only streamlined both processes, but guaranteed that the clinical information is entered at every encounter: physicians are required to complete the encounter (billing) form.

In turn, this requirement ensured that the clinical data from each primary care or specialty visit is available and accessible to the doctor, at the point of service, for the lifetime of the patient. By December 1997, physicians were documenting online significant diagnoses, conditions, procedures, drug allergies, and medications prescribed for patients throughout ambulatory care.

In order to continue to add immediate value to patient care activities, enhanced documentation features are added to the system as they are developed (see Table 1). Continuous project design and development cycles require ongoing implementation phasing as new functions are introduced. Each phase involves a number of steps:

- Analysis of patient and work flow, with suggestions for improvements
- Application design by an interdisciplinary team of users
- Customization of application software
- Interdisciplinary feedback sessions to refine product
- Development of system and training documentation
- Provider and user training
- Testing of application; assessment; improvement
- Software implementation and support

Development of a Primary Care Chart

Priority for system development and implementation was given to outpatient services generally, and primary care services in particular: medical primary care (adult), women's health services, and pediatric primary care, (including adolescent health services). During the summer of 1997, the HIS project team assessed the patient and work flow in the various primary care clinics, and developed a statement of work for those areas. These statements were approved by the clinical and administrative department heads, and then presented to an interdisciplinary work group. Included in this group were several representatives of the medical records committee, the director of health information management, the medical directors of the primary care services, as well as ambulatory care nurses and administrators.

A document describing the proposed components of an electronic primary care patient record was presented to, and then modified by, the group. The work document included descriptions of the types of information to be entered into the system, who the data would be entered by, how the information would be presented, and where the information would be stored. This effort supported the medical staff and administrators in their conceptualization of the interactive process required to design and develop a product that would meet their clinical and informational needs. Discussions were focused on assuring that system implementation would augment rather than disrupt patient care. The proposal was modified, and finally approved by the HIS steering committee (see Figure 1).

Once the overall framework and its components were approved, design teams from the various services were convened to define and approve the details of their particular applications. Each module was tested and piloted on a controlled basis before service-wide implementation. Prior to implementation, the appropriate documentation was written by the project team, and training provided to the staff.

Table 1. Elmhurst Hospital Center HIS Transition Plan

| <i>Begin implementation</i> | <i>Application</i> | <i>Provider</i> | <i>Service</i> | <i>Paper chart</i> | <i>EMR</i> |
|-----------------------------|---|------------------------------------|----------------------|--------------------|------------|
| January 1997 | Lab order entry/results | MD | Ambulatory care | ✓ | ✓ |
| | Radiology orders/results | MD | Ambulatory care | ✓ | ✓ |
| | Patient problem list (diagnoses) | MD | Ambulatory care | ✓ | 2/98* |
| May 1997 | Encounter forms (codified) | MD | Ambulatory care | ✓ | 1/98* |
| August 1997 | Diabetic retinal exam orders/results | MD | Ambulatory care | ✓ | ✓ |
| | QHN merged patient record | MD | Network | ✓ | 8/97* |
| November 1997 | Rx orders/medication profiles | MD | Ambulatory care | ✓ | 10/98* |
| December 1997 | Patient summary problem list | MD | Ambulatory care | ✓ | 2/98* |
| | Allergy/ADR documentation | MD | Ambulatory care | ✓ | 2/98* |
| | Significant Dx/conditions | MD | Ambulatory care | ✓ | 2/98* |
| | Significant OP/invasive procedures | MD | Ambulatory care | ✓ | 2/98* |
| | Psych encounter forms (codified) | MD, psychologist, social worker | Mental health | ✓ | 3/98* |
| March 1998 | Vital signs and measurements—adult | MD, nurse, CNM, PA, NP | Med sub, MPC, WHS | ✓ | 10/98* |
| | Patient initial intake—adult | Nurse | MPC, Med sub | ✓ | 10/98* |
| | Adult immunization | Nurse | MPC, Med sub | ✓ | 10/98* |
| | administration/documentation | | | | |
| | HMT alerts and reminders—adult | MD | Ambulatory care | ✓ | 10/98* |
| | Adult nutritional screen and referral | Nurse, MD, CNM, NP, PA | MPC, Med sub | ✓ | 10/98* |
| | Psychosocial screen and referral—adult | Nurse, MD, CNM, NP, PA | WHS, MPC, Med sub | ✓ | ✓ |
| | Vital signs and measurements—pediatrics | MD, nurse, NP, PA, MD, nurse | AHS/PPC | ✓ | ✓ |
| | Pediatric HMT alerts and reminders | MD, nurse | Pediatrics | ✓ | ✓ |
| | Pediatric growth chart | MD | Pediatrics | ✓ | ✓ |
| | Anticipatory guidance | MD | Pediatrics | ✓ | ✓ |
| | Age specific milestones <5 Yrs | MD | Pediatrics | ✓ | ✓ |
| | Anatomic pathology orders/results | MD | Network | ✓ | ✓ |

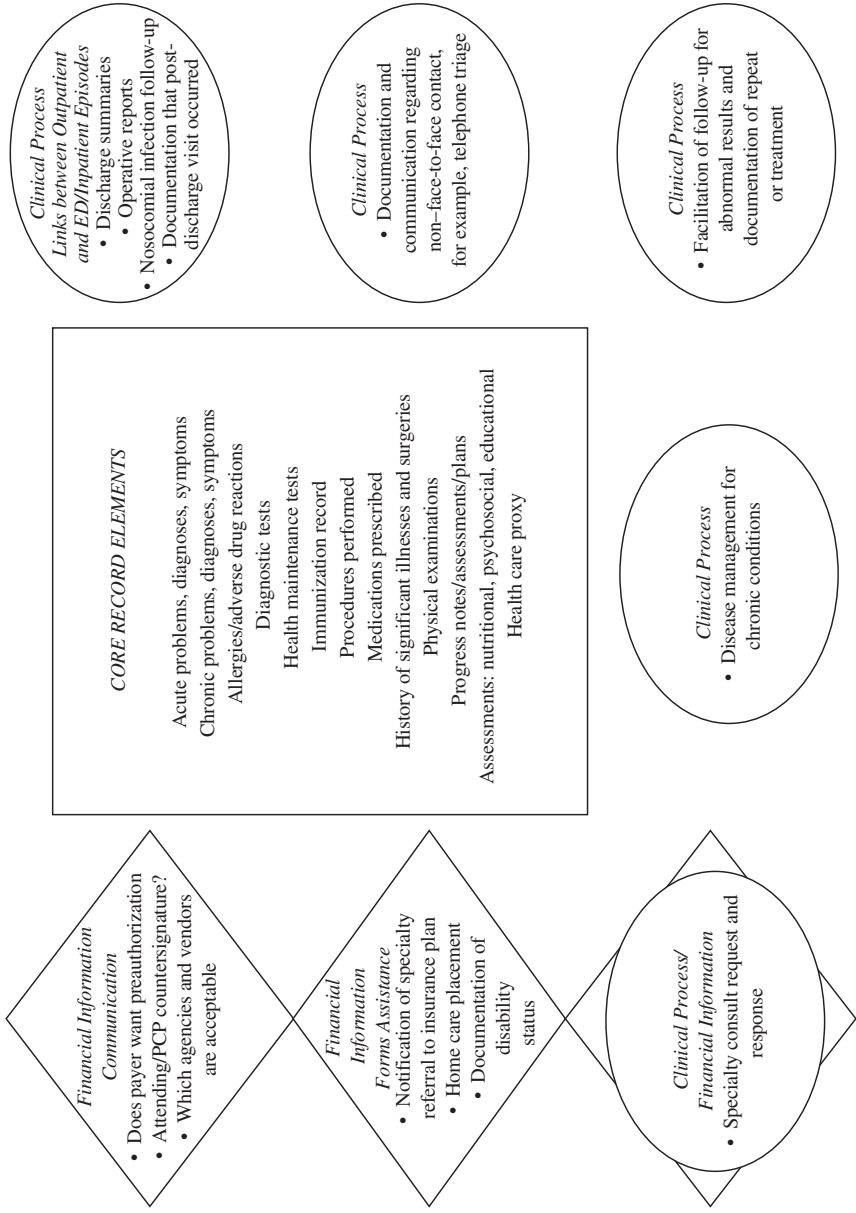
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|---------------|-------------------------------------|---|--------------------|---|--------|
| July 1998 | Nutritional assessment—adult | Dietitian, health educator | Ambulatory care | ✓ | 10/98* |
| January 1999 | Social work assessment—adult | Social worker | Ambulatory care | ✓ | 5/99* |
| | Social work progress note—adult | Social worker | Ambulatory care | ✓ | 5/99* |
| | Radiology system conversion | All | All | ✓ | 1/99* |
| | Radiology resource scheduling | All | All | ✓ | 1/99* |
| | Radiology voice recognition | All | All | ✓ | 1/99* |
| March 1999 | ID interdisciplinary assessments | MD, nurse, social worker, dietitian, psychologist | Infectious disease | ✓ | ✓ |
| | Telephone triage | Nurse | Network | ✓ | ✓ |
| June 1999 | Childhood immunizations conversion | MD, nurse | Pediatrics | ✓ | 7/99* |
| | Cytopathology conversion | MD, CNM, PA, NP | Ambulatory care | ✓ | ✓ |
| | Consult/referral requests | MD, CNM, PA, NP | Network | ✓ | ✓ |
| | Managed care rules and alerts | MD, CNM, PA, NP | Network | ✓ | ✓ |
| | Prenatal assessment | Nurse, MD, CNM, PA, NP | WHS | ✓ | ✓ |
| November 1999 | Prenatal nutritional screen | Nurse, MD, CNM, PA, NP | WHS | ✓ | ✓ |
| | Patient/family education assessment | Nurse, health educator | Ambulatory care | ✓ | ✓ |
| | Consultant response | MD | Network | ✓ | ✓ |
| | Physician progress note | MD | Network | ✓ | ✓ |
| | History and physical exam | MD | Network | ✓ | ✓ |

Note: Most elements are available in the paper chart and online (EMR).

* Dates indicate transition to EMR complete.

Service abbreviations: Med sub—medicine specialties/subspecialties; MPC—medical primary care (adult); WHS—women's health services; AHS—adolescent health services; PPC—pediatric primary care.

Figure 1. Elements of an Electronic Primary Care Chart



System Security and Patient Information Confidentiality

Access to the EMR is limited to those employees who require specific patient information, and the level of access varies dependent upon an individual's discipline or work function. For example, clerical and administrative staff, physicians and midlevel providers, and RNs and various other nursing personnel, have different security levels, and see varying amounts and types of information. Access is restricted on a "need to know" basis.

Users are issued an electronic key at training, *and* must choose a system password that changes every three months. At the initial training session, every employee signs a confidentiality statement. Both the physical device (key) and the electronic password are required each time a user signs on to the HIS. Every admission to a patient's chart review is recorded automatically. The system generates an audit trail that lists admissions and modifications to each patient's file, by user, with a record of the date and time.

User Training and Support

User training is coordinated with the clinical and ancillary departments, and scheduled at the convenience of the providers. Training is provided whenever a new feature or function is introduced, at any time upon the request of the user or user's supervisor; and to all new employees whose patient care functions require documentation on the HIS.

Ongoing training of physicians and other patient care providers is required for several reasons: Continuous system design and development guarantees that the HIS is constantly changing, to reflect users' needs and priorities—new functionality is continually being requested, tested, piloted and implemented; the needs of the various primary care and specialty care patient populations have widely disparate requirements; each month, medical and surgical residents rotate into the network from its medical school affiliate; and the transformation of physician practice patterns, and the integration of new technology, requires constant reinforcement. The emphasis is always on improving support for patient care providers, to enhance the quality of patient care.

Training and support is provided by the staff of the HIS help desk, who triage calls, and walk users through the applications when necessary. If the problem cannot be resolved over the phone, a help desk member is immediately dispatched to the clinic to address the software issue, or replace hardware, as appropriate. This immediate response is essential in a busy patient care environment, where no system downtime or delay is acceptable. Call logs are maintained, helping to identify application features that require reinforcement or redesign.

Continuous Quality Improvement

An ongoing needs assessment process defines the efforts of the HIS project team. Requests from all levels of clinicians and administrative staff for new features or system enhancements are forwarded to the project manager. As appropriate, group or individual meetings are held to refine issues, which are then referred to the regularly scheduled development committee and steering committee meetings for consideration and prioritization. Competing needs are juggled and progress is monitored. Improvements and further changes are implemented as required.

By the middle of 1998, interdisciplinary patient assessments had been implemented in various primary care and specialty care clinics. Documentation features are customized to serve the needs of the different patient populations, then modified and improved after feedback from physicians and other care providers. For example, an initial intake tool for adult primary care patients was implemented, including a nutritional screen performed by nursing staff. The system calculates a score based on the patient's responses to a series of screening questions. When the score reaches a defined threshold, the patient is electronically referred for a full nutritional assessment. The clinical information is then routed to an electronic work queue to be reviewed and augmented online by the dietitian assigned to that patient population. As the information is updated at subsequent visits, or by other care providers, the computer screens are refreshed, eliminating the need to repeat efforts by staff or patients to communicate.

The paper form that was in use in the primary and specialty care services provided the basis for the development of the electronic intake tool. Based on user feedback, changes were made to the calculations used to determine nutritional risk in the adult population. Additional work with physicians and other clinicians made it clear that the nutritional requirements for obstetrical and pediatric patients varied from the general adult population, and required two additional sets of calculations to support their particular patient care needs. As the utilization of these documentation tools is expanded, providers will continue to be polled to determine the effectiveness of the tools. Changes will be made as necessary and appropriate, to improve the data collection process and patient care.

Measuring Success

By January 1999, the QHN HIS included 1,400 personal computers with associated peripherals, used daily in examination rooms by 750 physicians, nurses, mental health providers, social workers, health educators, and dietitians to document integrated patient assessments. Patient care providers throughout ambulatory care enter and retrieve patient data at the point of service. The EMR has become an essential component of the management of patient care

across the network, with ever-increasing demands for its enhancement and expansion.

Laboratory and radiology results are integrated, timely, and accessible in exam rooms in offsite and on-campus clinics, and in school-based health centers across QHN. The widespread availability of these and other clinical data supports ongoing efforts in the continued regionalization of duplicative and competing clinical services, and the decentralization and expansion of others. The HIS allows real-time access to patient information anywhere in the network. Consider an Elmhurst patient referred to Queens Hospital for a head MRI. The radiologist can now review prior visit history and diagnoses, results of general diagnostic radiography and CT scans, BUN, creatine and other recent lab values, and ensure that the patient does not have a contrast allergy before the technologist performs the test. The fact that the patient is followed at another facility in the network is no impediment to access to vital information. Availability of clinical information online surmounts one of the biggest obstacles to integrated, seamless care across the entire spectrum of healthcare services.

As a byproduct of having linked clinical to financial data in the patient problem list, the quality of the data used for billing has improved. The process of tying clinical to financial data had been predicated on an extensive review of the paper systems, during which old codes and diagnoses were deleted or updated, and new ones were added. Now, the physicians can also access the current ICD-9 code book in its entirety online.

In October 1998, the JCAHO survey team awarded the EHC ambulatory care services a rating of 100 percent (EHC overall received accreditation with commendation). In previous surveys, the hospital had received citations for inadequate documentation on the patient summary problem list, as well as nutritional assessments. Certainly, the quality of the clinical documentation has improved, and the clinical data is legible and more complete.

The Future of the HIS

Following the installation of Ulticare radiology at both Queens and Elmhurst in 1998, efforts to increase overall system integration across the network are being reemphasized. Development priorities for 1999 include documentation of childhood immunizations, with the conversion of an existing standalone database at Elmhurst, and implementation of pediatric health maintenance test alerts and reminders; and electronic notification to physicians of managed care requirements regarding preauthorization and referrals.

In addition to the components of the primary care chart that have been implemented, there has been work on the design of a chart for rehabilitation medicine, and another for ambulatory mental health services. Efforts at Elmhurst are currently focused on completing the transition from paper to electronic patient assessments throughout ambulatory care. Several additional

components of the primary care chart have been completed and are ready for training and implementation: prenatal assessments, nursing telephone triage, and patient and family education. The various options for the inclusion of progress notes online are being evaluated from the clinical, technological, and operational points of view. In addition, efforts have begun to define the elements of the patient history and physical examination.

The implementation of an HIS for ambulatory care is only the beginning. Efforts are underway to retire legacy systems to take full advantage of emerging technology. Voice recognition has been implemented in radiology, with digital radiography and a picture archiving and communication system soon to follow. In addition, to provide real-time, online patient data across the continuum of care, plans will be initiated to design and develop applications for the emergency department and the inpatient units, and to integrate home health care. By definition, the healthcare information system is dynamic, interdisciplinary, and interactive, and it is being developed in a continuous process of improvement as patient, physician, and organizational needs evolve.

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