# Improving Information Access with an Emergency Department System

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*An emergency department (ED) clinical system was developed by in-house personnel, with ED physician, nursing, registration and clerical staff input. The utilization of existing hardware and customization of the hospital's mainframe hospital information system (HIS) facilitated the implementation of a cost-effective system that meets the information access needs of a busy, state-of-the-art academic ED. The transition to automation of the ED was facilitated through the use of a comprehensive training plan and change strategies.*

## INTRODUCTION

Hospitals are installing ED computer systems to track patients throughout their stay in the emergency department.[1-3] Most institutions are acquiring stand-alone ED computer systems that are then linked to HIS via interfaces.[4] We developed an ED patient tracking system as part of our mainframe HIS system. The goal of the system was to improve staff access to key information in a new, larger, and more complex ED facility. The former ED facility comprised 8,700 square feet, whereas the new department would be 24,000 square feet. The department would also expand, to include pediatrics acute care and urgent care areas, for an increase from 23 to 53 beds.

The transition to an automated clinical information system represented a major cultural change for the staff, and required a comprehensive training plan that included basic personal computer (PC) and HIS training, as well as culture change strategies. Prior to the implementation of the computer system, the majority of the ED nursing staff did not use computers daily in their work. Although the clerical and physician staff did use computers regularly for some functions, they were utilizing manual systems to access patient tracking information, on-call lists, and beeper directories.

## METHODS

### Resources- Assessment
Both free-standing and mainframe-based ED systems were reviewed by the hospital Information Services Division (ISD). It was determined that in-house human resources were in place to develop the ED tracking system. Expected advantages of the HIS-based system over a stand-alone system included full integration with existing on-line registration, clinical and financial information, integration with current and future order entry functionality, integration with bed control, medical records, labor and delivery and inpatient departments, no need for interfaces, and in-house computer support.

### Resources- Utilization
The software development was accomplished by a multi-disciplinary project team, with dual project managers: a master's prepared emergency nurse with expertise in ED computer systems, and the associate director of ISD. A formal process of systems development methodology was utilized by the project team, and included the establishment of functional requirements through staff surveys, site visits, tracking system vendor demonstrations, and flow charting current and desired patient information access processes.[4-5]

The hardware resources required for the new system included networked PCs, dot matrix and laser printers, and large display monitors. The networked PCs and printers were already included in the resource allocation for the new ED, and provided access to multiple systems including existing HIS-based registration, clinical, financial and order entry functionality, as well as the clinical workstation and medical school network software. The large display monitors represented the only hardware expenditure unique to the new ED tracking functionality.

### Information Access- Assessment
An assessment of the information access needs of the ED staff was conducted both before and after implementation of the automated system. The first assessment took place two years prior to the move to the new ED facility, and a post-implementation evaluation of information access was conducted seven months after the new system went live. In the first assessment a focus group of 50 ED nurses, physicians, registrants, clerical staff were surveyed after attending a vendor demonstration and reviewing literature about ED computer systems. The staff were asked to complete surveys regarding information access in the

ED. Consent to participate in the review process was conveyed by returning the completed surveys, and the study was given exempt status by the Institutional Review Board (IRB). Staff members' names were not associated with their questionnaires. Questions included "What information do you waste a lot of time looking for?" and "What information do you need in the various areas of the ED, but currently don't have easy access to in that location?" The clerical staff were asked, "What information do you get asked for repeatedly?" Twenty-four staff members completed the surveys, for a 50% response rate. Respondents included staff nurses, attending physicians, clerks, registration staff, volunteers, and managers.

The post-implementation assessment was administered to 100 ED nurses, physicians, volunteers, clerical and registration staff. The staff were asked to consider each of the priority items identified before, and rate whether they were "still a problem in the new ED," or "not a problem in the new ED."

**Information Access- System Design**
The project team used the staff's input from the information access surveys to prioritize the items of highest and high priority (see Table 1). The top priority was improved access to information about clinical results. Decisions about the disposition of ED patients often hinges on clinical results such as lab data and x-ray findings, and quick notification of the availability of results is a key factor in efficient ED operations. Existing manual processes of notifying clinicians of completed clinical results often contributed to increases in patients' length of stay in the ED. The system plans included an order status flag for radiology, with a future plan to incorporate lab order status in the tracking system.

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| --- |
| 1. Order status (ordered, pending, results available) |
| 2. Patient tracking (pt name & location, RN & MD) |
| 3. Physician on-call lists |
| 4. Beeper numbers |
| 5. Patient disposition from ED (home, admitted) |
| 6. Physicians' plan of care |

**Table 1- Information Access Priorities for New ED**

The next priority was online access to patient tracking information, with multiple entry and display points throughout the ED. The new system was designed to include online access to key patient tracking information, via 26 PC's and 11 large display monitors located throughout the department.

The staff also requested improved access to on-call lists and beeper numbers, which were previously only available in written form in limited locations in the ED.

The project team created an automated on-call list and added the existing computerized beeper directory to the new ED online menu.

In response to requests from management and research staff for improved quality of ED data from the HIS, the new system was designed to capture key information at the point of the patient's contact with the ED staff members collecting the information. Prior to the automation of the department, clerical staff were responsible for entering the majority of the clinical and operational data into the computer retrospectively. Key information, such as time data, was recorded manually by various staff members throughout the patient's stay in the ED, and great variation existed in the accuracy of the information. The automated ED tracking system was built for concurrent data collection: the triage nurse enters triage data during triage, the physicians enter care provider data at the time they see the patient, and bed control staff enter the admission referral data at the time they receive the ED physician's admission referral.

**Computer Training- Needs Assessment**
An assessment of computer training needs was conducted before the implementation of the new system. Questionnaires were completed by all of the 120 ED nurses, nursing assistants, clerks, registration staff, attending and resident physicians who would be working in the new ED, for a 100% response rate.

**Computer Training- Plan**
A comprehensive training plan[6] was then developed, which included customized schedules for each staff member, based on self-reported teaching modality preferences and training needs. A variety of training classes and self-learning packets were provided to all 120 ED staff members. Training classes included basic PC skills classes for inexperienced staff, basic mainframe-HIS classes for nursing staff who had not worked with the HIS, and mandatory ED system classes for all ED staff.

Seven staff members attended a basic PC course designed for computer-phobic persons. Ninety-five nursing and physician staff needed general HIS training as well as specific new ED system training. The HIS training was offered in two modes: hands-on class in the computer lab, and self-learning packets. Forty staff preferred to use the self-learning packets for the HIS system, and 40 attended a class on the HIS. The twenty-five clerical staff members were current HIS users, and required only an update on the new ED system. All 120 ED staff members attended training classes on the new ED system. Class content and length varied, depending on the user group's level of

involvement with the automated functionality and their familiarity with the HIS system. Physician classes were 45 minutes, clerical classes were two hours, and nursing classes were 2.5 hours. At the completion of each class, staff were required to demonstrate competency in performing key functions for the user group.

Other training strategies included train the trainer, utilization of the online practice ED system, installation of additional PC's for practice in the old ED facility, and use of parallel online and manual systems for one month prior to implementation of the new system in the new ED

## Culture Change- Assessment
Both before and after implementation of the automated system, all ED nursing staff were given a questionnaire that asked about their attitudes and beliefs regarding computers. The surveys were reviewed and considered exempt by the IRB. Completion of the questionnaires was optional, and staff conveyed their willingness to participate by returning the anonymous surveys.

Twenty-eight of the fifty nursing staff completed computer attitudes and beliefs surveys one year prior to the implementation of the new system, for a 56% response rate. Thirty percent of the respondents reported that they did not believe that computers were easy to use. Twenty-one percent said computers required excellent typing skills, and thought that they would have to learn a computer language to use the new ED computer system. Although the ED had several clinical workstation computers, 50% of the nurses reported that they did not use a computer in their daily work. There were paper alternatives to the online processes at that time. Feedback included comments from several nurses who stated that their belief that the ED would "come to halt if you expect us to type patient data into a computer and still triage all the patients coming in."

The project team also conducted site visits and consultations with other hospitals that had implemented ED computer systems. Other hospitals reported difficulty in getting physician participation with automated ED operations. ED managers and system analysts reported that physicians showed resistance to taking on "clerical data entry tasks."

## Culture Change- Plan
The change literature was consulted, and culture change strategies were employed to facilitate the automation of manual processes.[7, 8] An early strategy was strong commitment of resources by ED nursing management. The project team included staff nurse

and clerical staff involvement at every level of system development, training and implementation, and the nurse educator was assigned to the project in the capacity of project manager full-time for nine months.

Another change strategy was regular communication with ED personnel at staff meetings, and through a new ED bulletin board. Project team members shared the training plan, maps, diagrams, photographs and articles on pertinent subjects. The system was also developed so as to limit redundancy, by combining the triage assessment and initial entry of the patient data into the tracking system. The project team sought to present the task of initial patient entry into the computer not as an additional step, but as a replacement of the manual triage process.

Physician involvement in the in-house system development process was also a key factor in the culture change. Physicians attended early system demonstrations, and provided key input, including the need for streamlined system sign-on processes and minimal keystrokes to enhance physician buy-in. The physician chair and the physician in charge of departmental informatics provided top-level support for physician participation with the ED computer system. All ED attending and resident physicians were notified that computer-training classes were mandatory, and that their use of computer system in the new ED would be monitored.

The ED clerical staff, who were experienced HIS-users, were trained on the new system first, and became champions of the automated system. Early train-the-trainer sessions were utilized for key nurses from each shift who had been identified as superior teachers and mentors. Both the trainer-nurses and the clerks then provided one-on-one demonstrations and instruction to the nursing and physician staff on the unit throughout the training period.

## RESULTS

The new ED opened May 7, 1996, and the tracking system has tracked over 150 patients a day from the outset. One year post-implementation, the system processes 60,000 ED/Pediatrics Acute Care/Urgent Care visits annually, up from 38,000 ED visits annually before the new system was developed.

## Resources
The potential personnel costs for the software development were $97,800 over a 15-month period; the actual costs were negligible since the project team members were in existing positions and continued to be paid by their own departments during system

development. The software was planned by the project team, and developed by ISD programming staff over a 9-month period of time. Testing was done by the project team and representatives from affected departments, including ED staff, Bed Control, and Labor and Delivery. Training was provided by the ED project manager with assistance from other project team members.

The potential hardware costs for the new ED system were $142,600, which included networked PC's, printers, a server, and large display monitors. The actual hardware costs for the new ED tracking system were $42,000. The remaining hardware costs were absorbed by existing resources and budgets for other clinical computer functionality.

## Information Access

Fifty staff members completed the post-implementation surveys, including 25 nurses (50% response) and 5 physicians (50% response). The majority of the staff reported that access to key patient tracking information was no longer a problem in the new ED (see Table 2). Staff now access these data from any of the 26 PC's or 11 large display monitors located throughout the clinical area. Many of the respondents reported that access to order status, on-call schedules, beeper numbers, patient disposition and the physician's plan of care were still problematic.

| Still a problem post-implementation? | | |
|---|---|---|
| | Nurses | Physicians |
| Lab results order status | 38% | 60% |
| Patient names (eg, pt in Bed 5) | 0% | 0% |
| Patient location in ED | 4% | 0% |
| Physician caring for patient | 10% | 20% |
| On-call schedule | 36% | 50% |
| Beeper numbers | 46% | 50% |
| Patient disposition | 67% | 77% |
| Physician's plan of care | 74% | 100% |

**Table 2 - Information Access in New ED**

Data is entered concurrently into the ED computer system by triage nurses, registration staff, clerical staff, physicians, and clinical area nurses as they care for patients. The integrated HIS also captures data on ED patients at the point of service by other departments and post-visit, including clinical laboratories, bed control, admitting, medical records, inpatient staff, physician billing, and patient accounting data.

## Computer Training

All 120 ED staff members attended training classes on the new ED system, and 100% successfully completed post-training competency evaluations.

Seven months after going live, a post-implementation assessment of the tracking system found that all 120 ED nurses, registrants, clerical staff, and physicians were using the automated ED computer system daily in the clinical area. No staff turnover occurred due to the inability to use the computer in their daily work. There have been no patient complaints related to delays in processing ED patients due to the computer system. Neither have there been any negative clinical events at triage because the nurses enter patient data into the computer instead of completing the triage assessment documentation manually.

## Culture Change

A post-implementation assessment of the nurses' attitudes and beliefs regarding computers was conducted during the seven-month evaluation. Twenty-five nurses responded, for a 50% response rate. Only one nurse reported the belief that computers were not easy to use. Twelve percent of the respondents felt that computers required excellent typing skills, although 20% still believed that knowledge of a computer language was required to use the new ED computer system.

Staff have submitted requests and documented problems in an ED Computer Log kept in the clinical area. At the request of physician staff, pathways were modified post-implementation to decrease the number of keystrokes required to enter the physician provider codes. Resident and attending physicians use the system to enter their provider code at the time they go in to see ED patients. Ninety percent of the clerks, nurses and physicians reported in the follow-up evaluation that access to the name of the physician taking care of the ED patient is "not a problem in the new ED."

Regular system evaluations and ongoing training are necessary to maximize utilization of the system. A clerical supervisor's duties have been realigned to include 20% time devoted to managing the ED computer system. Since the system was implemented, staff report major problems with access to patient tracking information during computer downtime. Revisions to the downtime procedures and additional training for all clerical and charge nurse staff have been necessary to optimize patient information access during and immediately after downtime.

## DISCUSSION

The project team succeeded in designing a system to meet the clinical users' needs for easily accessible patient tracking information in a new, larger, more complex ED. A key to success was the integral

involvement of ED staff in the development of the system. The majority of the staff's highest prioritized information items were incorporated into the automated information system. The new system was developed with minimal costs, through utilization of existing human and hardware resources, and integration with the current HIS system through custom design.

Some of the continued deficiencies in information access in the ED are related to the hospital information system plans as a whole. Order status continues to be a concern, and is not currently included in the automated ED clinical information system. Although order status was a high priority for the ED system, lab order entry was part of a separate, hospital-wide project. Lab order entry was successfully implemented in the ED six months after the new ED computer system went live. Full automation of laboratory, as well as radiology, order status is under consideration as an enhancement to the original ED system.

The computer-human interface continues to be one of the challenges to effective use of computers in the clinical environment. Staff still report problems accessing some information in the new ED, including beeper lists, on-call schedules, the physician's plan of care, and patient disposition. The beeper list is available online and updated regularly by the hospital communication staff. The list is accessed via the ED main screen item labeled "Profiles," which may not be an obvious link to the beeper list. Staff retraining may improve access to the online list. Automated systems can provide accurate information only when users regularly update information. The on-call schedules must be updated several times daily by ED clerical staff, and clinicians report that the information is not always current.

User problems are related to some of the continued deficiencies in information access in the ED. The manual ED tracking board in the former facility included a space for the ED physician's plan of care for patients, but was not consistently used. The plan of care was included in the new system, and the physicians have been encouraged to add a brief plan to the computer system display screen. However, the computer data entry field is also optional, and continues to be utilized only sporadically by the ED physicians.

The transition to automation of the ED's clinical information system was facilitated by a comprehensive training program and inclusion of strategies to bring about a cultural change in the department. The trainer nurses and clerical staff were active in providing one-one teaching prior to the system going live. They also supported the project through positive attitudes and generally acting as champions of the computer system. Staff utilized the online practice system and additional PC's extensively, and reported that the practice time increased their confidence with the computer system. The top-level physician endorsement and mandate for physician utilization of the system fostered acceptance of the computer as a part of the ED physicians' daily work.

## CONCLUSION

A comprehensive ED computer system was developed to meet many of the departments' information access objectives. The process was facilitated by the utilization of staff input, a formal systems development methodology, commitment of the necessary resources, and top-level administrative support. Hospital-wide information system issues and the human-computer interface continues to be challenging aspects of the clinical informatics arena.

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