Evaluating Success

Strategies and Challenges for Understanding IT Implementation in a Rural Hospital

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KEYWORDS

Healthcare information technology, computerized patient records, inpatient care, hospitals, rural.

ABSTRACT

In 2004, a small rural hospital in California received a grant for the implementation of an integrated IT system. As part of the grant, the hospital worked with a university team to evaluate the implementation. The evaluation plan emphasized quantitative analysis of medication errors, patient safety and hospital finances. As the implementation progressed, it became clear that the quantitative methods would be marginally useful; qualitative methods gained greater importance. The evaluation team added more interviews and several staff surveys to the evaluation. The results of the surveys helped the hospital team understand how well staff was prepared for the technology and how they were responding to implementation. The best practices emphasized in this paper include: work with independent evaluators who can provide anonymity and lend objectivity; focus on surveys and interviews to understand the difficulties faced by staff and how they might affect outcomes; and collect key outcomes data in advance of beginning the implementation.

Over the past decade there has been a gradual increase in the number of hospitals adopting electronic medical records and medication administration systems.[1-3] By 2006, approximately 51 percent of hospitals had electronic nursing documentation; 43 percent had computerized provider order entry; and 35 percent had barcode systems for pharmacy administration.[4]

These systems are expected to bring about improvements in patient safety,[5-9] but so far results have been mixed.[10-16] Hospital information technology can have unintended consequences: Poor design can compromise patient care or distract providers from care delivery. The implementation period is particularly important.[17,18] During implementation, new procedures and processes are established, creating an environment in which change can beget errors.

Because the implementation period is important to eventual success of IT systems, it is essential that IT installations are evaluated. This paper describes a prospective evaluation of an IT implementation in a rural California hospital. The hospital received a grant from AHRQ for the implementation of an integrated IT system and worked with a university-based research team to develop an evaluation. As described here, the initial evaluation plan proved to be infeasible and minimally useful. Thus, the evaluation strategy was changed to meet the needs of the hospital as well as expand knowledge that can guide other hospitals implementing IT systems. This paper reviews the lessons learned in developing a useful, successful evaluation when preparing for an IT implementation.

BACKGROUND

In September 2004, a 112-bed acute-care hospital in a rural community was awarded a grant by the AHRQ to implement and evaluate an integrated hospital IT system. The hospital is operated by a local healthcare district and is located in a Primary Care

Health Profession Shortage Area (HPSA). The hospital serves a medically underserved population, with 66 percent of the hospital's patients on Medicaid or Medicare, and 12 percent uninsured.

The hospital received the grant in partnership with a health information system vendor, which had worked with the hospital since the late 1990s. Previously, the hospital had installed the company's financial management products, as well as a few clinical applications. For the new grant, the hospital planned to implement numerous components to create an integrated IT system with an electronic medical record. The new components included pharmacy management, laboratory management, operating room management, patient scheduling, insurance eligibility verification, bar coding for supplies and medications, Pyxis medication dispensing system, electronic medication administration records, electronic patient care documentation, computerized provider order entry and Web-based access to hospital records by community physicians. The project had five stated goals:

1. Successfully deploy a fully integrated EMR system using proven health IT practices to reduce medical error and improve overall patient safety.

2. To decrease the number of medication errors.

3. To provide private physicians and local clinic physicians the opportunity to utilize CPOE to reduce medication errors.

4. To provide private physicians and clinics in the hospital's service area the opportunity to access patient information remotely via a fully integrated EMR.

5. To evaluate and analyze data resulting from health IT implementation in order to assess the extent to which health IT contributes to measurable and sustainable improvements in patient safety and quality of care in rural hospitals.

Because the hospital did not have the capacity to evaluate the effect of the IT system on patient safety, they contacted the University of California, San Francisco, to conduct the evaluation.

We had no previous relationship with the hospital, but were familiar with the community in which the hospital operates and were conducting other research in the region. We were completing a multi-site retrospective evaluation of computerized patient records and bar-code scanning for medication administration in the Veterans Health Administration, and had conducted several prospective evaluations of workforce development programs. We had not previously conducted a prospective evaluation of an IT installation.

THE INITIAL EVALUATION PLAN

The evaluation plan emphasized quantitative analysis of medication errors, patient safety and hospital finances. Reduced medication errors were expected to result from the eMAR, Pyxis and CPOE. Patient safety was expected to improve as a result of the aforementioned modules, as well as the laboratory and operating room management components, bar coding, electronic patient care documentation and physicians' Web-based access to records. Finally, the operating room management, bar coding, scanning and insurance eligibility components were intended to improve the hospital's financial position.

The hospital would provide most of the data required for the quantitative evaluation. The hospital's incident reporting system would provide data on medication errors by type, procedure errors, patient complaints and other incidents. The hospital submitted data on nurse staffing, patient falls and decubitus ulcers quarterly to a statewide quality improvement program. We also planned to compute Patient Safety Indicators and Inpatient Quality Indicators using software developed by the AHRQ. Finally, financial data would be obtained from both the hospital and a state regulatory agency.

By the end of the first year, it was clear that some aspects of the implementation were going well and others were problematic. As we scheduled the first set of interviews with hospital leaders, we also decided to recruit staff for interviews.

Quantitative analyses were framed by specific hypotheses, which focused on potential differences between the short-run and long-run effects of IT. It was expected that short-term patient safety indicators and medication error rates would appear to worsen, due to improved accuracy in identifying errors with electronic systems. In the long-term, error rates would improve. The data analyses would first involve simple comparisons over time, and then multivariate regression equations would be estimated to control for other factors that may have affected patient outcomes, such as patient acuity. These multivariate regression equations would be estimated using ordinary least squares and econometric models appropriate for count data, and would control for correlations within patient care units. The data requirements for this quantitative approach were significant, and IT systems had to be implemented according to the proposed schedule to have enough data for a reliable pre/post-analysis.

The original evaluation plan also included interviews with the top management team, unit managers, the pharmacy director, the operating room manager, the human resources director and head nurses, using a written guide to provide some structure to the interviews. The primary purpose of the interviews was to assess the financial impact of the IT system. It was expected that top management would report satisfaction with the systems because they have better access to information about hospital operations. Front-line managers were anticipated to think that initial implementation of the systems was difficult but that the IT system was beneficial by the end of the project. The proposal did not focus on the process of implementation, nor did it specify the frequency of interviews or include non-management hospital staff.

RESEARCH IN MOTION

The leadership of the hospital was enthusiastic about their plans for launching an IT system and established an aggressive implementation timeline. The first components—the pharmacy man-

agement system and Pyxis medication dispensing units—were launched within the first month of the grant, because the bulk of the installation preparation was conducted before the grant began. The implementation of Pyxis was universally praised by hospital management, and the roll-out was accelerated due to staff enthusiasm. During the remainder of the year, the hospital planned to install electronic patient scheduling; a bar coding system for supplies; operating room management; a scanning application for archiving records; electronic laboratory management; and eMAR. Of these, only two more modules were launched in the first year: electronic patient scheduling and bar-code scanning for supplies.

Setbacks came during the first quarter of the grant and continued throughout the year. First, the IT vendor's project manager left and the hospital's clinical IT implementation coordinator went to another hospital. The replacement project manager was a long-time non-clinical employee of the hospital, who had been in various roles in the clerical and administration departments. The Chief Nursing Officer (CNO) of the hospital was charged with training and supporting nurses, pharmacists, physicians and other clinicians. The next setback came with the electronic scanning module, because the underlying software referred to a hard drive that could not be used for the application. The IT vendor had to reprogram the software and new hardware had to be ordered, setting the implementation behind schedule; this module was implemented more than one year late. Other modules scheduled to be implemented in the first year were delayed, including operating room scheduling and management and eMAR.

Adding surveys to the evaluation. As difficulties with the implementation became apparent, we decided to augment the evaluation with interviews and surveys to learn how staff were perceiving and responding to the implementation. The first survey was intended to measure overall attitudes toward computer technology, and the role of computer technology in healthcare, before many of the IT modules had been implemented. Survey items were drawn from a previously developed instrument to assess acceptance of computer systems in the healthcare setting.[19] A variety of survey instruments have been used in previous research. A useful resource is Anderson and Aydin's *Evaluating the Organizational Impact of Healthcare Information Systems*.[20]

Survey participants were recruited via flyers posted at the hospital. The response to the survey was disappointing. Some survey responses suggested that there was distrust of management among some staff; the fact that the hospital is small might have raised privacy issues for staff respondents. In general, participation in evaluation efforts may be influenced by political, social, labor and personal issues at the hospital and among staff. It is important for evaluators to develop protocols to increase staff comfort with participation in surveys and interviews. The low response rate of 68 convinced the evaluation team to use different dissemination methods for future surveys.

The second survey added to the evaluation plan was designed to learn about nursing documentation before the electronic patient documentation system was released. For this survey, participants were recruited at the beginning of their training class for the patient care documentation system. The trainer directed class attendees to a short Web-based survey, which had been adapted from a survey developed by Russ Cucina at UCSF and shared through personal communication. They survey asked staff to report the time spent collecting and entering chart data, as well as their expectations for electronic patient care documentation. The response to this survey was nearly double that of the first survey, with 133 respondents. Making the survey readily available to respondents during a dedicated time was an effective strategy to ensure good response while maintaining confidentiality.

A third survey, conducted about six months after the eMAR system had been implemented, was to explore how well staff thought eMAR training had prepared them for its launch, and whether eMAR was perceived as increasing patient safety, saving time and providing useful warnings and alerts. This survey was adapted from one developed by Julie Sakowski for unpublished research on the Sutter Health System's bar-coding system for medication administration, received through personal communication. Neither of the two previous survey administration strategies was considered for this survey. Participants were recruited with flyers posted in the hospital and through the efforts of project staff at TDH. The recruitment flyer offered participants a gift card for their participation in the survey. Potential participants could obtain an envelope containing the recruitment letter, a one-page survey and a return envelope from one of the managers involved in the IT implementation. Staff was instructed to seal the survey in the envelope provided and return the sealed envelope to the IT implementation coordinator in exchange for a gift card. This survey method resulted in 117 respondents from a range of occupations at the hospital.

A final survey was distributed after the second launch of the patient care documentation system, which had been implemented and shut down the previous year. The survey process was the same as that used for the previous survey on eMAR use. Staff participants were recruited with flyers posted in the hospital and through the efforts nursing management, who identified staff that had experience with the module. As before, participants received a gift card for their participation in the survey. The survey had only 50 respondents, likely because the patient care documentation system was not being used by most staff due to a variety of ongoing hardware and software problems. This final survey asked about time spent collecting and entering chart data, to compare the data received from the pre-training survey with the post-implementation data. The survey also asked about ease of use, completeness and accuracy of the electronic record, and satisfaction with the system. These survey questions were extracted from several previously published surveys.[21,22]

Expanding the scope of interviews. By the end of the first year, it was clear that some aspects of the implementation were going well and others were problematic. As we scheduled the first set of interviews with hospital leaders, we also decided to recruit staff for interviews; the experiences of staff were regarded as key to the overall success of the IT implementation. We recruited staff for interviews by asking the IT implementation coordinator to post flyers at the hospital, offering a gift card as an incentive, and instructing staff to call UCSF to schedule an interview. To ensure confidentiality, 10 staff members were interviewed in

a private conference room at an off-site fitness center owned by the hospital. Staff members were generally satisfied with the IT system, although several complained about problems they were having with the software. Others thought that the IT system had been selected without enough research.

The first interviews with hospital leaders were conducted in an office at the hospital. All interviews were one-on-one and were not tape recorded. Most of the hospital's leaders recognized that there were some implementation problems. Several expressed some frustration with the IT vendor. At the end of the first year, leaders were uncertain about whether there would be improvement in quality of care when the IT system was fully installed, and leaders were divided as to whether they anticipated a positive long-term financial gain from the electronic systems. Hospital leaders reported that the IT system was more expensive than expected in the first year.

A second set of staff interviews was scheduled for the end of the second grant year, but was deferred. The primary reason for delaying the second site visit was that neither the eMAR nor the patient care documentation system had been implemented during that year. These were two of the most important components of the IT system. Moreover, the IT vendor informed the hospital that the CPOE module was not yet ready for use, and they could not estimate when it would be ready. We decided to delay the site visit until after at least one of these modules had been implemented.

While we were waiting for progress at the hospital, the hospital went through a year of turmoil. There was a series of disruptive changes in senior management, starting with the CEO of the hospital going on medical leave. One month later, the CFO was fired. Over the next several months, the CEO retired due to his medical condition; the Chief Nursing Officer was fired; and the COO resigned. The IT implementation coordinator, hospital IT manager and a nurse manager continued to push forward with the implementation plan, but with no high-level continuity because the hospital was managed by an all-interim executive team. Over a year after the upheaval began, the hospital's board appointed a permanent CEO, providing stability to the hospital for the first time in nearly two years.

The site visits started again six months after the eMAR system was launched, while the interim executive team was in place. Interviews were conducted with these interim leaders, as well as 11 staff members. The staff had been recruited through flyers posted at the hospital, as before, and interviewees were offered a gift card to thank them for their time. Interviews were held in a private conference room at the hospital. Conducting interviews in a closed-door room was the key to ensuring confidentiality and candor. Due to scheduling difficulties, some staff asked to conduct their interview by telephone after the site visit. We found that these interviews were less useful, for several reasons. First, we suspect that staff did not reveal as much in the telephone interviews, because they could not develop a rapport with the interviewer as easily as they could in person. Second, we could not observe the body language or facial expressions of the interviewee; non-verbal cues often led us to follow-up questions during in-person interviews. It is preferable to conduct all interviews in person, if possible.

A final set of interviews was conducted during the last month of the evaluation period. We interviewed nine staff members, using the same recruiting and interviewing strategy as for the previous set of interviews. During that final visit, most of the permanent executive team was in place, and we interviewed the CNO as well as the leaders involved directly with the IT implementation. This was the third time we had met the IT implementation coordinator, IT manager, and nurse manager leading the implementation. The final interviews with the leadership team provided an opportunity to ask closing questions such as: "If you had the chance to do this implementation again, would you do it, and what would you do differently?" We also were able to provide some feedback about approaches the hospital might consider for future IT implementation.

Scaling back the data analysis. The implementation delays experienced at the hospital meant that there was not sufficient post-implementation data to assess the impact of the IT system on patient outcomes. Moreover, the nuances of the implementation suggested that any improvements would not arrive for many years. The quantitative analysis was modified, because the degree of statistical rigor originally proposed was not feasible. We obtained data from the hospital's incident reporting system, state-filed financial records, and nurse staffing and quality data. Some hospital leaders thought the medication error reporting as too low, and thus there was some concern about the validity of those data. We graphed each of the key outcomes—such as patient falls, operating margins and medication errors—and indicated on the graphs when each of the major IT modules had been implemented. Most of these simple analyses did not show any apparent changes in rates of patient safety incidents, but a few indicated that there may have been a worsening of outcomes after the patient care documentation system was implemented.

Several recent studies have used innovative strategies to prospectively or retrospectively collect data on patient safety, and how IT might affect patient outcomes. Poon et al.,[23] developed a protocol to directly measure errors in pharmacy dispensing before and after a new bar-code dispensing system was implemented. A research pharmacist inspected all medications after normal dispensing and verification processes, and classified each error. A panel of internists then reviewed and rated the severity of each error. This research method was labor-intensive but produced reliable counts of errors pre- and post-implementation. Sakowski et al.,[24] retrospectively audited warnings and errors reported generated by a bar-coding medication administration system to estimate how many medication errors had been averted by use of the system.

CONCLUSIONS AND RECOMMENDATIONS

As health information technology systems diffuse through the healthcare industry, it is essential that knowledge about how to effectively implement these systems be obtained and disseminated. Formative evaluation, which focuses on the process of implementation rather than the outcomes, can enable organizations to make changes while they are in the midst of an implementation, and can provide essential information about implementation strategies that work.[25]

Many healthcare organizations do not have the capacity to

conduct their own evaluations, and even those that do may benefit from working with an external evaluation team. Independent evaluators can lend objectivity to the research, because they do not have professional relationships with hospital staff and leaders that might compromise neutrality. Moreover, non-employee evaluators can provide anonymity to staff who may be concerned about whether their candor puts their standing in the organization at risk.

Qualitative evaluation of the implementation process is needed to understand how IT systems are affecting staff workflow, morale, and perceptions of quality of care. Three qualitative data collection strategies can be considered: focus groups, interviews, and surveys. Focus groups provide an efficient method to learn how staff is adapting to IT, but these groups do not provide staff with anonymity. If staff are worried that their views will not be popular or might place their professional reputation at risk, they will not speak candidly in groups. One-on-one interviews are advantageous because they give the interviewee the opportunity to discuss concerns and successes privately. Anonymous surveys also can provide useful information during an implementation, and a growing number of survey instruments for IT evaluations are available.[20,26] For all qualitative data collection methods, it is useful to offer staff an incentive to participate, such as a gift card.

Quantitative data collection is needed to evaluate the outcomes of health IT implementations. Careful prospective data collection can be time-consuming expensive; the work by Sakowski[23] and Poon[24] involved large research teams and intensive data collection and review. This effort was rewarded with the ability to accurately measure the impact of health IT. Retrospective analysis of previously collected data is less expensive, and thus attractive to hospitals that cannot afford a large research budget, but there is a trade-off with respect to the quality and reliability of the quantitative evaluation results.

Organizations should use published studies along with their internal research findings to develop and refine their IT implementation strategies. As IT modules are launched, data on how staff perceives the quality of training, whether support is adequate, and the emergence of unintended negative effects can be used to ensure that subsequent launches work better. The evaluation effort is worth at least minimal investment and, as with many other things, greater investment often leads to greater rewards. **JHIM**

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