

Implementation of Practice Guidelines in a Clinical Setting using a Computerized Knowledge Base (Iliad)

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ABSTRACT

We present the implementation of the indications for surgery for three surgical operations - cholecystectomy, cataract extraction, and knee arthroscopy- in a medical expert system, called Iliad®. This implementation operates in the preauthorization service of IHC Health Plans (an insurance company in Salt Lake City) as a basis for reimbursement of services. Patient data collection forms, derived from Iliad knowledge base, were used by 13 participating surgeons to document the objective patient observations that justify the surgery and, then were faxed to IHC where a trained nurse input the data in Iliad. Iliad's decisions and reports on any deviations from guidelines are communicated back to the care provider.

The study evaluates the impact of the computerized implementation on process, as measured by a questionnaire, and on outcome as measured by rate of approvals, documentation level, rate of requests, and average cost. The prospective implementation of the computerized guidelines has performed reliably, has been perceived as a preferred alternative to the old preauthorization system, and, most importantly, has enhanced significantly the level of documentation permitting evaluation and determination of appropriateness before surgery.

INTRODUCTION

Medical societies, organized medicine, insurance companies, regulators, and the peer review organizations are all interested in practice guidelines [1-5]. Practice guidelines have two goals: first, determine what is medically necessary and then pay appropriately for it; then, once a decision is made, provide case specific advice on how to best implement the decision [6-12]. In this paper, we are primarily interested in the first goal, that is, the appropriateness of the medical decision.

Evaluation of the impact of practice guidelines in the current preauthorization setting have rarely been completed.

The current manual preauthorization protocol is based on general rules that are broad, permissive and inconsistently applied due to variations in interpretations between preauthorization nurses. The current rules do not necessarily reflect existing practice guidelines and have not been reviewed and endorsed by health care providers. But more importantly, the current documentation of indications is subjective, shallow and sometimes conflicting. Finally, there is inadequate feedback to physicians regarding the deviation of their specific practice pattern from existing guidelines.

Medical expert systems offer a unique opportunity to improve the effective use of guidelines and to decrease the cost of implementing them. Such systems can accurately and consistently evaluate compliance with the guidelines, generate case specific feedback, and insure complete documentation of the data necessary to evaluate the indications for surgery in a particular case [14].

We present a study that evaluates the implementation of the guidelines for three surgical procedures using the medical expert system Iliad. The objectives of the study are to test whether Iliad can be used as a preauthorization tool for screening requests for surgery and to measure the impact of this intervention on health care cost and physician practice patterns. Specifically, we are interested in evaluating whether:

- a computerized version of practice guidelines is feasible, and can provide a more effective work flow alternative,
- documentation of a patient's indications for surgery is improved and is adequate for evaluating electronically compliance with guidelines,
- the cost of the workup before surgery decreases with the use of the computerized guidelines,
- the system has an effect on the rate of requests for surgery.

METHODS

We present the methodology used to develop, implement, and evaluate the guidelines for three surgical procedures using the medical expert system Iliad as a preauthorization tool.

Development of surgical indications in Iliad

The credibility of an expert system in medical procedures pre-screening is perhaps the most critical factor of success [5]. To accomplish this goal, we have followed a formalized process refined during the development of the Iliad internal medicine database [13]. The result represents a consensus among the variety of sources used and the medical professionals from IHC Health Plans and the University of Utah Medical Center.

An expert librarian who was interested in outcome research helped retrieve from the medical literature relevant articles regarding the appropriateness of specific medical procedures. Since practice guidelines are likely to be published in commonly read journals, Medline has been the major resource used. The search strategy was centered around the procedure name "anded" with subheadings such as "st" (standards), "ut" (utilization), "ae" (economics), as well as text words such as "practice guidelines", "indicators", "preauthorization". The articles retrieved were reviewed by the appropriate domain experts.

In each of the domains of surgery considered in this study, an expert met several times with the knowledge engineering team to extend the information in the literature through her own experience. The knowledge representation models combine Boolean and Bayesian logic [13]. When a criteria refers to a diagnosis already available in the Iliad internal medicine knowledge base, the corresponding diagnosis criteria have been used (e.g., acute cholecystitis). This inclusion is an essential factor to our strategy since the system uses objective, direct observations as the basis for its decisions as opposed to recording subjective or undocumented judgments. A set of patient charts was obtained to refine the knowledge base as well as to provide a measure of correctness of its decisions. The last step in this knowledge engineering process involves a panel of respected practicing surgeons in the community that were invited by IHC Health Plans and who met to discuss the criteria embedded in the system until a consensus was reached. The result of this engineering process is an expert system that is used to request relevant patient data, to evaluate conditions indicating a given medical procedure and to generate reports explaining and documenting the reasons why the procedure is or is not justified in the present case.

Operational setting

Following the methodology described above, we have developed and validated a computerized knowledge base that defines the indications and contraindications for three surgical procedures: cholecystectomy, cataract extraction, and knee arthroscopy. From these guidelines, forms were developed that list the patient data necessary to evaluate each of these procedures. Since the physicians participating do not have a computer in their offices, these forms represented a valuable alternative until a computerized data communication link is available in each surgeon office.

Four clinics involving 13 providers contracting with IHC Health Plans in Salt Lake City, Utah, participated in this initial implementation of the computerized protocol. The forms were sent to all four clinics ahead of time to allow the preauthorization personnel to familiarize themselves with the content. During a luncheon meeting held a week later, the new preauthorization process was demonstrated and initial training was provided to the attendees. The forms were faxed to IHC Health Plans (if there was no access to a FAX machine, the information could be called in). In either case, the information was evaluated using the new computerized criteria and the clinic was informed as soon as possible regarding the status of the preauthorization request. Each preauthorization review was accompanied by a full report based on the computerized guidelines. The report contained information about the logic of the computerized knowledge base and deviation from this logic and was designed to improve compliance overtime.

The study lasted nine months, period during which we cumulated about 20 cases per month across the three procedures, corresponding to a total of 180 cases.

Evaluation design

This study investigated the influence of the preauthorization expert system on the quality of the documentation and the appropriateness of the decision to perform surgery. At the same time, the study aimed to solve operational issues associated with the implementation of computerized guidelines in a clinical setting.

In a first part of the project, each of the following parameters were measured before and after implementation of the system, for comparable periods of time:

- rate of completed electronic evaluation of appropriateness (whether the request is approved or referred),

- level of documentation of preauthorization records (i.e., average number of observations in the electronic preauthorization form),
- level of documentation of surgeons' records (i.e., average number of observations in the preauthorization form actually documented in the patient chart),
- average cost of the medical procedure including workup cost as determined from preauthorization forms,
- average number of requests per month.

A sufficient number of cases related to the three procedures were obtained from the control period. A quality assurance nurse reviewed the cases and entered the medical information (existing as free-text in the preauthorization record) into Iliad. With the help of Iliad, the nurse evaluated the adequacy, objectivity and completeness of the documentation. We hypothesized the data recorded during the control time period would be insufficient to complete the evaluation using the computerized protocol.

In a second part of the project, we evaluated how the computerized guidelines influenced the process of preauthorization. We hypothesized that the convenience of the fax communication, the enhanced documentation and the system's prospective feedback about appropriateness would provide benefits that outweigh the required efforts of more detailed documentation. To test these hypotheses, we measured user satisfaction as well as the time spent in processing the new forms with this new preauthorization protocol by means of a questionnaire.

RESULTS

The study was conducted between April and December 1992. The nine month pilot project involved 141 patient cases: 19 cholecystectomies, 15 cataract extractions, and 107 knee arthroscopies.

Impact of Iliad on rate of approvals

For each of the procedures, a query to the IHC Health Plans system was made to print all cases performed by the physicians involved in the pilot project during the time period between January 1, 1991 and December 31, 1991. From these lists a 20% random sample of cases was selected resulting in 14 cholecystectomies, 2 cataract extractions, and 22 knee arthroscopies. All information gathered for the purpose of preauthorization was entered into the Iliad system. Approval is defined as compliance with the logic in the Iliad system. The results are displayed in the following table:

	before Iliad	after Iliad	Chi (p-value)
chole	2 (14%)	12 (63%)	7.882 (.01)

cataract	0 (0%)	13 (87%)	
knee	2 (9%)	99 (93%)	74.746 (.005)
global	4 (11%)	114 (81%)	62.766 (.005)

Once the missing information was accounted for, all requests were approved. The inability to "approve" automatically each case is due to insufficient documentation. For instance, in cholecystectomy, information to support the pain of biliary colic (specific location, radiation, time pattern of the pain), and information to rule out pancreatic, liver, renal, or ulcer disease were lacking. In cataract extraction, there was insufficient information to confirm dysfunction that impairs patient life-style (unable to read, drive a car, etc.), or to quantify impaired vision even with best correction. In knee arthroscopy, all 14 knee cases were referred for essentially the same reasons. Information lacking included specific x-ray findings, positive physical orthopedic findings (anterior drawer, pivot shift, Lackman's or McMurray's, etc.) and response to previous non-operative therapy (NSAIDs, physical therapy), if any.

Impact of Iliad on the level of documentation

The results of this section are listed as the total number of cases and the average number of relevant data elements recorded for each case by type of procedure:

	before Iliad	after Iliad	t test (p-value)
chole	14 avg=4.0	19 avg=17.5	4.375 (.0005)
cataract	2 avg=4.5	15 avg=53	8.155 (.0005)
knee	22 avg=3.6	107 avg=16	7.513 (.0005)

The computerized protocol asks for more information (i.e., data elements) to make a determination. Notice that, with an average number of finding "after" of 17, 78% of cholecystectomies were approved, whereas when the average "before" is 4, only 14.3% are approved. The same correlation may be drawn with knee arthroscopies.

Also, it is worth noting that before intervention all the findings recorded were positive, whereas after intervention about 1/3 of the recorded findings are negative.

Evaluating the accuracy of the information collected in the forms

To evaluate the reliability and reproducibility of the information collected in the forms, we requested a number of patient records selected at random from the set of cases obtained after intervention. Five patient documents were obtained from the clinics. These documents are partial patient charts including operation reports, pathology reports and office visit

records. Evaluation of the first patient case confirmed that all the information reported in the form was documented by the surgeon in the patient chart. In the other four cases, it was not possible to confirm the accuracy of the main data elements, and in one case, contradictory information was noted.

Impact of Iliad on health care cost

	before Iliad	after Iliad	t test (p-value)
chole	14 avg=\$141	19 avg=\$230	3.329 (.005)
cataract	2 avg=\$35	15 avg=\$74	5.965 (.0005)
knee	22 avg=\$0	107 avg=\$35	2.352 (.025)

Since the Iliad approach requires more data elements, we would expect it to be associated with a higher cost. However, if patient cases were matched before and after intervention (in terms of similar case severity, co-morbidities, and reasons for the surgery), such a difference may disappear. For cholecystectomy, the higher cost was due to the acalculous cases (\$321) versus the cholelithiasis cases (\$141). The cost of cataract is difficult to judge since there are only two cases before intervention. The minimum possible cost would be the cost to evaluate the visual acuity (\$35). The second part of the cost occurred with the visual field evaluation or the PAM study, which is necessary if there is maculopathy or if the physician needs to assess the benefits of the operation. In the case of knee arthroscopy, again we have not matched the cases for the medical condition preceding surgery (i.e., ligament, patellar, meniscal, synovial, articular).

Impact of Iliad on number of requests

The total number of requests (and average per month) for each of the three procedures before and after the Iliad intervention are tabulated below:

	before Iliad	after Iliad	t test (p-value)
chole	70 avg=5.8	19 avg=2.4	8.485 (.0005)
cataract	10 avg=.8	15 avg=1.9	2.015 (.05)
knee	110 avg=9.2	107 avg=13.4	4.370 (.0005)
global	191 avg=15.9	149 avg=20.3	2.124 (.025)

The same clinics and physicians contributed their cases before and after intervention. Note that the number of requests decreased for cholecystectomy and cataract extraction but increased for knee arthroscopy.

Impact of Iliad on user satisfaction

A questionnaire was developed to assess the impact of the new computerized protocol on user satisfaction and work flow. Out of 7 participants (personnel actually completing the forms sent to IHC Health Plans), 7 responded (100%). All the participants are females, with an age average of 43. Their background is as follows: medical assistant (3), medical secretary (2), and nurse (2), with an average stay in current position of 4.1 years. The preauthorization activity occupies on average of 4.5 hours per week. As to the overall feeling about the new computerized preauthorization using Iliad, the ratings are: very good(2), good(2), fair(3); faster (4), no difference (1), slower (2). The medical personnel were asked to compare the computer-based procedure to their phone-based procedure. The results reveal an evenly distributed rating: more difficult (3), not different (1), easier (3). Reducing the number of questions in the form to a minimum would be welcome: too many (4), about right (3), too few (0).

The impact of Iliad on the work flow seems advantageous, as faxing the forms at a convenient time was appreciated by all.

Another important question dealt with the source of the data reported in the forms. All the participants reported that they extracted the information from the chart on their own. The reports produced by Iliad, including the reasons why the guidelines were or were not met in a given case, were judged not to be useful at this point.

DISCUSSION

The current prototype study has taught us a number of lessons.

- Computerization of the practice guidelines performance is adequate and the system seems to behave accurately. The decisions made by the system on the 141 submitted cases were accepted by both the provider and the insurance company.
- Implementation of a computerized patient record to document patient condition before surgery is feasible, and is perceived to provide for a more effective communication alternative between the provider and the insurance company. The impact of Iliad on the work flow seemed advantageous because of the fax convenience.
- The overall level of documentation has improved. The forms recorded more explicit information from the provider than the nurses did during the manual process (before intervention). The new system collected an average of 4 times more data about a case than was recorded manually, allowing Iliad to reach a decision in most of the cases as opposed to only rarely before intervention. Iliad has not

increased or decreased the rate of approvals but has significantly increased the quality of the documentation and consequently allowed for electronic review of requests. It is worth noting that since most malpractice cases are lost because of lack of documentation, in the future, the improved quality of the documentation may prove very valuable to demonstrate "good practice" and protect against liability.

- The system appeared to lead to higher costs in some cases. To achieve the level of documentation required by the protocol, more laboratory tests and procedures have been documented. However, if the documentation for cases before intervention was more complete and if patient cases were matched before and after intervention in terms of similar case severity, co-morbidities, and the reasons for the surgery, such a difference may be reversed.
- This study was not specifically designed to measure changes in rate of requests. Based on the data obtained, the rate seemed to decrease for cholecystectomy and cataract extraction, and to increase for knee surgery. Several variables (months in which the study took place, individual physician and/or clinic practice patterns, changes in "natural" health care trends such as an upper projectory) which could have an effect on request patterns were not controlled. And it is possible that a clinic may have simultaneously used the manual preauthorization method for some of its cases, hence underestimating the request rate after intervention.

Furthermore, the sample size in the current prototype is too small to warrant any definitive conclusion. In addition, it was felt that in general the three procedures considered were not abused and that the surgeons that participated spontaneously in the study were practicing in a more than appropriate fashion.

FUTURE PERSPECTIVES

We carried a preliminary prospective study in a clinical setting to implement a computerized version of surgery guidelines using financial incentive to enhance physician compliance. We have successfully solved operational issues, but more importantly, we have shown that extensive detailed electronic documentation of the indications for surgery is possible and is associated with increased rate of automatic "approval." This may lead to the ultimate goal of waiving the preauthorization requirement for clinics where satisfactory case documentation is maintained. In the future, it will be necessary to

establish more definitive results by increasing the sample size and increasing physician involvement. We are also seeking more commitments from the surgeons to author the patient information in the preauthorization form or, better still, make the form their primary documentation, to read and sign the reports acknowledging the feedback about their compliance with the guidelines.

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