Decreased hospital length of stay associated with presentation of cases at morning report with librarian support

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Objective: The research sought to determine whether case discussion at residents’ morning report (MR), accompanied by a computerized literature search and librarian support, affects hospital charges, length of stay (LOS), and thirty-day readmission rate.

Methods: This case-control study, conducted from August 2004 to March 2005, compared outcomes for 105 cases presented at MR within 24 hours of admission to 19,210 potential matches, including cases presented at MR and cases not presented at MR. With matching criteria of patient age (± 5 years), identical primary diagnosis, and secondary diagnoses (within 3 additional diagnoses) using International Classification of Diseases (ICD-9) codes, 55 cases were matched to 136 controls. Statistical analyses included Student’s t tests, chi-squared tests, and nonparametric methods.

Results: LOS differed significantly between matched MR cases and controls (3 days vs. 5 days, \( P < 0.024 \)). Median total hospital charges were $7,045 for the MR group and $10,663 for the control group. There was no difference in 30-day readmission rate between the 2 groups.

Discussion/Conclusion: Presentation of a case at MR, followed by the timely dissemination of the results of an online literature review, resulted in a shortened LOS and lower hospital charges compared with controls. MR, in association with a computerized literature search guided by the librarians, was an effective means for introducing evidence-based medicine into patient care practices.

INTRODUCTION

Morning report

“Morning report” (MR), along with grand rounds, is one of the most visible educational traditions in internal medicine [1, 2]. MR describes a case-based conference in which house officers, attending physicians, and often the program director or chair of the department meet primarily to discuss the care of patients [3]. It is generally assumed that MR educates physicians and plays an important role in the education of house officers. According to Parrino, most internal medicine training programs require that the house officers participate in MR [2]. MR is an educational process by which the house officers attempt to solve a diagnostic puzzle, teaching them that making an accurate diagnosis can be a thoughtful and complex process. Because the initial diagnosis made in the first twelve hours after admission to the hospital may differ significantly from the final diagnosis, one of the main functions of MR is to assist the house officers with further developing diagnostic skills [4]. Furthermore, the presentation of cases in a “real-time” format can enhance the learning process. As each new piece of information is revealed, new steps unfold in the reasoning process that engage participants’ attention and develop house officers’ problem-solving skills [5, 6].

Anecdotal data indicate that MR formats at different institutions vary and range from a brief discussion of each patient admitted to a service overnight to a detailed presentation of a newly hospitalized patient or a hospitalized patient with unusual findings. There is no clear consensus on the most educational or relevant approach; however, participating house officers expect to address the diagnostic evaluation of specific syndromes, the clinical features and mechanisms of dis-

Highlights

- Morning report, with accompanying literature search results, can provide house officers with information that improves patient care and can lead to a positive impact on length of stay and hospital charges.
- Physician comments indicated that collaboration between the library faculty and physicians increased the visibility of librarians, making physicians aware that librarians’ searching expertise can improve the relevance of the information retrieved.

Implications

- As librarians and physicians work together, physicians increase their awareness of resources and services offered by the library.
- The combination of case presentation and literature support employed in this approach may be worth pursuing in other teaching hospitals due to associated educational and financial benefits.
ease, and the appropriate tests and procedures [7]. Like much of the approach to medical education, there is no recognized “best” way to effectively meet these educational expectations [8] or determine whether MR discussions affect patient outcome.

Morning Report at the Louisiana State University Health Sciences Center in Shreveport

The overall purpose of MR in the Department of Medicine at Louisiana State University Health Sciences Center in Shreveport (LSUHSC-S) is to teach residents how to logically analyze the presented case and to identify the correct course to take to reach a diagnosis and therapy. MR is one of the educational foundations of the internal medicine training program, occurring from 8:00 a.m.–9:00 a.m., five days per week. Typically, the discussion is led by the chief resident with support by the program director, associate program directors, and sometimes the chair of medicine. Approximately 2 dozen residents, department of medicine faculty physicians, and a reference librarian also attend. One inpatient case is presented in the standardized format by the resident who conducted the initial evaluation. The chief resident is responsible for facilitating a patient-centered dialogue by recording the case information on a whiteboard. As the case is presented, the residents are expected to decipher its diagnostic puzzle. If time allows, treatment options are also discussed.

In June of 2004, prior to the current study, a data-gathering survey was distributed to evaluate department of medicine house officers’ perceived value of locating clinically relevant literature for cases presented at MR. Following each MR, an online literature search was conducted by a librarian and a house officer on the basis of two questions jointly formulated by the presenting house officer and the senior members of the clinical faculty. The survey was then administered to sixty of the house officers by one of the participating librarians, who had no administrative authority over the house officers, as part of the department of medicine’s annual orientation program. The survey was intended to determine whether this intervention was useful to the house officers. Among the thirty-three house officers who replied to the survey, twenty-four stated that they read the medical literature emailed in response to these questions. Of the thirty-one respondents to a query regarding whether the information altered patient care, seventeen reported in the affirmative, noting that they ordered different laboratory tests, changed their diagnoses, or altered therapy in response to the information provided.

Answering clinically oriented questions is one strategy for incorporating evidence-based medicine into daily practice [9]. Librarians are well positioned to assist in this effort by reducing the time and effort required for clinicians to access the best available evidence. Librarians can not only assist physicians with finding answers to evidence-based questions, but also can make certain that “sources of real clinical answers are made accessible at the point of care” for the improvement of patient care [10].

Previous work by Klein explored the potential impact of librarian-provided literature on hospital charges associated with patient cases; this work, however, was conducted outside the context of MR [11]. The supposition in the current study was that collaborative efforts of the LSUHSC-S Medical Library and Department of Medicine had the potential to improve patient care by enhancing the educational impact of the department’s MR. Using librarians’ expertise in searching the medical literature, a plan was devised to identify and answer questions for each MR case through computerized literature searches followed by the immediate dissemination of this information to the care providers. This study explored whether the combination of MR and librarian-provided literature search results altered length of stay (LOS), hospital charges, or readmission rate of patients presented at MR.

METHODOLOGY

The partnership between the department of medicine and the medical library began with the education of the incoming 2004/05 internal medicine residents. The protocol for this study was approved by the LSUHSC Institutional Review Board in August 2004.

Intervention components

Each patient presented at MR was among those admitted to the hospital during the previous twenty-four hours to allow the MR discussion, literature searches, and dissemination of articles to affect patient care in “real time.” Although some laboratory results and imaging studies were incomplete at the time of presentation, discussing these newly hospitalized patients afforded an opportunity for the articles selected from the medical literature to directly affect patient management. Formerly at MR, complicated or unusual patients, regardless of their length of hospital stay, were presented and discussed, without attempting to highlight specific references from the medical literature.

Immediately following MR, the faculty librarian, with the clinical guidance of the chair of the department of medicine or the chief resident, conducted a search of the medical literature to identify citations to articles that answered two questions framed at the end of the MR session. In selecting the articles, preference was given to electronic full-text articles, although, in some instances, the best articles were available in print format only. The “best” articles were those that the chair of the department of medicine or the chief resident identified as providing the most clinically sound answers to the questions. The number of articles retrieved varied for each clinical question.

Copies of the selected articles were hand-delivered by the chair of the department of medicine or the chief resident to the presenting resident and shared by the members of the ward team by 10:00 a.m., so that team members could apply knowledge gained from the literature to the patient’s care. Each house officer was then asked to complete a form (Figure 1 online) to assess the quality of the information provided and to
determine whether this information was likely to influence the management of the patient.

Additionally, once the articles were chosen, a brief summary of the case was composed by the chair of the department of medicine or the chief resident and a librarian. This summary, along with the two questions and the abstracts of the selected articles, was disseminated by email with links to the full-text articles, when available (Table 1 online). The distribution list consisted of the department of medicine faculty, residents, and fellows, as well as rural Area Health Education Center (AHEC) providers affiliated with LSUHSC-S.

Case and comparison group selection and matching
During an 8-month period, 105 newly admitted patients were presented by house officers at the daily MR. One patient was presented during each MR. No directives as to which case to select or type of illness to present were given to the house officers. Each case was selected by the house officer based on interest in the patient’s illness, without the knowledge of the attending faculty physician or the investigators.

The comparison group was drawn from a computerized list of 19,210 in-patients who were hospitalized at the LSUHSC–S University Hospital in the previous 5 years and 7 months (1/01/2000–7/31/2005). Controls selected had the same primary International Classification of Diseases (ICD-9) diagnostic code as the 105 patients presented in MR. Further matching by patient age (± 5 years) brought the potential number of controls down to 4,655; matching on the number of concomitant secondary diagnoses (± 3 additional diagnoses) reduced the number to 3,060. Some of the 105 patients presented at MR had many matching controls (more than 3), while some had only 1. Randomly choosing no more than 3 controls per MR case resulted in 55 MR cases and a total of 136 closely matched controls. Fifty cases could not be matched with at least 1 control meeting the matching criteria and were not included in the analysis.

Outcome measurements
Data were extracted from the medical records of cases and controls for three outcome measures: the length of hospital stay, total charges for hospitalization, and readmission rate within thirty days of initial discharge. Physician charges were not included.

Statistical analysis
Student’s t tests and chi-squared tests were used where appropriate for unmatched analysis of differences between the MR group and the comparison group. Age, race, sex, number of disease diagnoses, insurance coverage, or marital status were compared between the two groups, as these factors might influence either length of stay or total hospital charges.

For the matched analysis, the outcome variables of interest, LOS and total charges, had a skewed distribution; therefore, nonparametric methods were used. Both the Wilcoxon signed rank test and the sign test were employed. Because there was a variable number of controls per case, a simple mean value of the ≤ 3 controls was used for LOS and total charges for the comparison group.

Values of the outcome measures for comparison of cases to controls were expressed as median rather than mean to reduce the influence of extreme values and outliers due to the asymmetric distributions of LOS and total charges. No outliers were discarded in the analysis. Group differences also were expressed as the median of the paired differences. P values less than 0.05 were considered to be statistically significant.

RESULTS
A total of 105 cases were presented at MR from August 2004 to March 2005. Not all of the matched cases were able to be matched with 3 controls. Out of 105 cases, 55 had at least 1 matched control, with a total of 136 controls (demographics in Table 2). For the unpaired data, there were no statistically significant differences between the 2 groups with respect to age, race, sex, number of disease diagnoses, insurance coverage, or marital status. The 50 cases that could not be matched with at least 1 control were not included in the main analysis.

Length of stay
Median LOS differed significantly between matched MR cases and controls (Table 3). The median lengths
Table 3
Total days of stay per hospitalization (n = 55 matches)*

| Morning report group | Matched comparison group | Difference | P value |
|----------------------|--------------------------|------------|---------|
| Mean                 | 6.85                     | 7.22       |         |
| Median               | 3.00                     | 5.00       |         |
| Standard deviation (SD) | 10.18                | 5.67       |         |
| Range                | 1.0–59.0                 | 1.33–33.0  |         |

* Wilcoxon signed rank test.

Table 4
Total charges per hospitalization (n = 55 matches)*

| Morning report group | Matched comparison group | Median of the difference | P value |
|----------------------|--------------------------|--------------------------|---------|
| Mean $15,142.88      | $14,951.49               | $14,951.49               |         |
| Median $7,045.11     | $10,663.06               | $10,663.06               |         |
| SD $22,401.40        | $13,312.03               | $13,312.03               |         |
| Range $2,295.40–$135,892.40 | $2,344.76–$58,687.19 | $1,392.48               | 0.24    |

* Wilcoxon signed rank test.

of stay were 3 days for the MR group and 5 days for the comparison group (P < 0.024). Figure 2 illustrates the range and distribution of length of stay data and the positive effects associated with presentation of the case at MR. Both axes are logarithmic scales, due to the extreme range of the data points. A greater proportion of points are above the line compared to the number of points below, indicating a shorter length of stay for the MR cases. The Spearman's correlation coefficient between matched pairs also was highly significant (P < 0.001).

Hospital charges and readmissions
Table 4 shows the median total hospital charges were $7,045 for the MR group and $10,663 for the control group. Although this difference was not statistically significant, the median of the differences of total charges for the MR cases was $1,392 less than for their matched controls. The log-log plot in Figure 3 illustrates the range and distribution for total charges. As with Figure 2, more points above the line indicate a beneficial effect of MR on patient outcome (in this instance, reported as cost of hospital stay), but the changes do not reach statistical significance.

The number of readmissions within 30 days of discharge was 9 out of 55 (16.4%) for cases and 23 out of 136 (16.8%) for controls. Both matched and unmatched analysis (not shown) found no significant difference between the readmission rates (P > 0.88).

Examining for potential selection bias
There was an additional analysis of cases (matched and unmatched) and potential controls to assess the possibility of selection bias. A multiple linear regression analysis of all cases and potential comparison patients was performed, adjusting for age, race, sex, number of concurrent diagnoses, marital status, and payment status. An indicator variable for matched or unmatched status was not significant in the model for either length of stay or total cost. After adjusting for demographic variables, the unmatched cases were not significantly different from the matched cases in terms of LOS or total cost. These results show that the study outcomes were not affected by selection bias. However, the investigators realize that the current study analyzed the outcome of only 55 patients out of a possible 19,210 and that sampling other individuals may have yielded different results.

Utility of literature provided
Table 5 online provides a summary of house officers’ responses regarding the usefulness of the articles provided by the librarians following each MR case presentation (sample comments in Table 6 online). The house officers commented on the quality of the articles for 60 of the 105 MR cases presented. Forty-three comments by the house officers indicated that the literature provided good
background information but did not change the management of the patients presented at MR. While the background information did not apply to the specific patients presented, house officers did mention that such information might be helpful in the future and added to their knowledgebase. Seven other comments indicated that the articles did not influence patient management in any respect, and no comments about the quality of the articles were provided for 45 of the MR sessions.

**DISCUSSION**

Clinical medical librarian (CML) programs were first reported in 1971 as a way for librarians to enter the hands-on world of patient care. In this setting, librarians were an essential element in physicians’ learning and teaching. They participated in the hands-on world of patient care. In this setting, librarians and house officers worked together in a variety of settings, from librarians accompanying physicians on rounds to attending teaching conferences or MR sessions [15]. Whatever the setting, a librarian shares expertise by either performing literature searches or training physicians to search the medical literature in an effective, efficient manner.

Some studies have focused on the clinical librarian’s impact on clinical decision making, finding that information provided by the librarian not only enhanced the educational value of MR but also had a positive impact on patient care [16–18]. Similarly, Klein, in a study undertaken outside of the clinical case review of MR, found a significant effect of librarian-generated MEDLINE searches on hospital charges, costs, and LOS [11].

There is substantial evidence that MR, apparently independent of format, results in educating house officers [19, 20]. Though others have shown that library services impact physician decision making [21], the investigators’ preliminary data-gathering survey in June 2004 showed that house officers perceived that patient care was enhanced by an online search of clinical questions developed at the end of the case presentation and answered in a timely way to allow for “real-time” changes in care. These preliminary data prompted the investigators to pursue a larger study to test this hypothesis.

This study was designed to succeed in the current climate in internal medicine training programs, delivering answers to the patient care queries to house officers who provide care soon after the presentation of the patient. Because patients were presented by house officers who had just recently completed overnight call and were subject to the thirty-hour work limit, the study protocol demanded a prompt “turn-around” time for delivery of relevant literature.

This specific MR model included a presentation by one of the house officers and a discussion led by the chief resident with the chair of the department of medicine, the program director, and several other faculty in attendance. The librarian attended the presentation and worked with the chair of the department or the chief resident to provide the best answer to the question posed at the end of the presentation. Conclusions made in this report reflect the implementation of this model. This study did not attempt to differentiate the contribution of the MR presentation from the librarian contribution, though this would be a useful consideration for future research.

In the face of increasing costs necessary to manage training programs, identifying educational programs that lessen the cost of care is attractive to medical educators and can help hospital administrators justify the cost of training. Finally, developing an intervention that promotes the utilization of online searching skills supports the American Council of Graduate Medical Education’s practice-based learning competency, which focuses on the resident’s use of information technology to access online medical information [22].

The study design was aimed to match patients and controls by demographic features and severity of illness. This was achieved by closely matching cases and controls to assure comparable levels of disease, risk, and comorbidity, each of which might affect LOS and hospital cost. The matching process appeared to be equitable and resulted in no apparent selection bias. Matched cases were slightly younger than unmatched cases, but this should not have affected the analysis because matched pairs of MR cases and controls were virtually identical in age. The interventions and con-
trols were found to be quite similar in all respects except the study outcomes.

Cases and controls were matched only by ICD-9 diagnosis code, without the decimal point, providing a closer match than could be achieved by using diagnostic groups. An even closer match could have been achieved by matching ICD-9 codes to within the first decimal digit, but this would have limited the number of cases for study even further, though with a more accurate estimation regarding the outcome variables.

The pairs were also matched on age (within five years) between intervention and control, leading to no significant difference in age between the cases and controls. Failure to match for age could easily affect the length of stay or total charges due to hospitalization of patients with widely varying ages, as one might assume that the older the chronological age of the patients, the longer they are likely to remain hospitalized and the greater the hospital costs.

Similarly, the pairs were matched on number of diagnoses (within three) between MR cases and the members of the comparison group. Thus, if a case had five secondary diagnoses along with the primary diagnosis (total number of diagnoses = six), then the respective comparison cases had a total number of diagnoses ranging from three to nine. Values outside this range might affect the LOS or total charges: with increasing number of diagnoses, care likely becomes more complex, leading to longer LOS and greater hospital charges.

It is not clear why statistically significant differences in LOS were not carried over into statistically different hospital charges between the two groups. Both the MR group and the comparison group had complex patients. The hospital costs for caring for such patients with multiple medical problems may be fixed to a large extent and may require a larger population to discern a difference.

Rates of readmission within 30 days depend on the type of diseases as well as the patient demographic characteristics. For example, about 5% of patients were readmitted to a hospital within a month of discharge in a rural health system [23]. In other groups, the readmission rate for internal medicine patients with select diagnoses over a similar time was 7.6% [24], about 10% for those with orthopedic illnesses cared for by hospitalists [25], and 15.7% for elderly patients with community-acquired pneumonia [26]. The university hospital at LSUHSC-S is considered a “safety net” hospital, providing care to a population of patients who have, on average, a low socioeconomic status. Complex medical problems are the norm among the hospitalized patients. With that background, it is not surprising that the rate of readmission is high, although similar for members of the “matched” and “unmatched” populations in the MR group. The rates for members of the matched and unmatched MR groups is representative of all patients on the medicine service and nearly identical to the 30-day readmission rate for in-patients discharged in the month of December 2006 (16.7%).

Limitations of this study include the small number of matched pairs, especially for older patients, and the high variability of the outcome measures, particularly total charges. Greater statistical power (i.e., more matched cases) may have allowed the detection of a significant effect on charges. The asymmetric distribution of both LOS and total charges complicates interpreting results with simple means and mean differences, forcing the use of medians and median differences. Transformation of the data by logarithms (not shown) yielded Gaussian (normal) distributions and the use of more powerful parametric methods of analysis; however, results were similar.

The investigators acknowledge that many events could have affected the outcome, resulting in a shorter hospital stay and lesser charges for the patients who were presented at MR and whose cases were addressed further with the help of the librarians. There may have been differences in the quality of care provided by the house officers or more effective interventions with newer therapies. It is also certainly possible that the house officers declined to review the information provided when they were caring for the patients. Nevertheless, the strength of the study design, the lack of bias in identifying which cases to present at MR, the lack of difference when comparing the matched to non-matched cases presented at MR, and the use of a widely accepted approach to the statistical analysis of the data provide the best protection that the conclusions are valid and that the described interventions altered patient outcomes.

Other factors, such as year-to-year variability or seasonal differences in the date of admission are also beyond the scope of this study to control. There can also be substantial variability between patients and diseases that also could not be controlled. It was not possible to identify specific changes in physician practice due to the MR or librarian-provided literature, yet the house officers did comment on how the articles influenced the management of their patients. Again, the differences in outcome in both LOS and in total charges, despite these limitations, show the strength of this approach.

This study illustrates that MR, including information provided through library faculty and physician collaboration, can have a positive impact on hospital charges and LOS. This collaboration has also been associated with added benefits, providing librarians the opportunity to help physicians improve their searching skills and recognize the librarians’ value.

The Institute of Medicine report, To Err Is Human: Building a Safer Health System, stresses the importance of forming interdisciplinary teams to improve access to accurate, timely information and emphasizes the necessity of providing up-to-date information at the point of care [27]. In this MR project, the LSUHSC-S librarians formed an interdisciplinary team with physicians and statisticians in the department of medicine and are continuing this collaboration. Now, house officers, instead of the chair of medicine, answer the questions generated at MR and search the literature with guidance from the librarians. In the present iteration of the collaboration, the librarians spend ap-
proximately one hour attending MR, one hour conducting a search, and additional time disseminating the appropriate articles.

The investigators have also initiated an internally accessible MR blog to capture cases, questions, and pertinent articles that answer questions raised during MR. The blog serves as a record of the MR sessions and allows interested parties to review the cases and search the blog to locate questions on various topics that have already been answered.

MR is a powerful educational intervention that may decrease patients’ LOS and cost of care. MR, in association with an online literature search and retrieval of relevant information, provided an up-to-date approach to the medical problems of patients and a significant reduction in median LOS for patients hospitalized on the internal medicine service. A larger study is warranted to confirm these changes and to better identify reasons for this success.

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