Improving Clinical Practice and Education Using the Electronic Medical Record – Can We Incorporate New Medical Research into Clinical Practice Using the Clinical Data Repository

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ABSTRACT

We investigated the potential for using aggregated medical records to tailor educational programs and incorporating new research into daily practice to improve clinical performance. In the past, nephrotic syndrome, a severe form of urinary protein loss had been described as a risk factor for venous thromboembolism. In May 2009, JAMA reported that even microalbuminuria or early mild kidney dysfunction is also a risk factor for thromboembolism. We used our existing clinical data repository to determine: 1. Did emergency department patients with thromboembolism have higher prevalence rates of microalbuminuria? 2. Can we use the data repository to aggregate historic clinical data to assist clinicians in evaluating pre-test clinical risk and improve decision support?

Key-words: Electronic Medical Records, Decision Support, Pulmonary Embolism (PE), Deep Venous Thrombosis (DVT), Thromboembolism, Microalbuminuria.

INTRODUCTION

In May 2009, JAMA reported that microalbuminuria or early mild kidney dysfunction is an important risk factor for venous thromboembolism (TE) [1]. TE includes both deep venous thrombosis (DVT) and pulmonary embolus (PE). Untreated, the mortality from PE is 25%. [2] PE is responsible for nearly 200,000 deaths per year and causes up to 15% of all hospital deaths. There are also long-term reductions in quality of life. This is an especially difficult diagnostic problem in clinical medicine because patient symptoms and signs are diverse or even silent [3]. The major screening blood test (d-dimer) has higher rates of false-positive test results in patients with renal disease, the gold-standard test for PE -- contrast-enhanced CT scanning may further injure the kidneys and increase future risk of cancer [2,4,5,6]. Finally, TE treatment has serious potential side effects.[7]

In the past, our team wrote code to extract data from the hospital information system where it was replicated every two hours in an Oracle database. Hospital information system code value tables were mapped to facilitate clinical and administrative research projects [8,9]. Available data includes demographics, chief complaints, vital signs, laboratory and radiology orders and results, discharge and admission diagnoses. In prior projects, we learned that some patients infected with new emerging organisms such as West Nile Virus were often missed early in the outbreak, and that patient chief complaints often do not match syndromic surveillance definitions [8,9]. In this project, we explore the feasibility of using this existing database to examine historic patient risk factors for serious conditions during current emergency department visits. Our research example was microalbuminuria as a new previously unrecognized risk factor for TE.
METHODS

This retrospective study was conducted at a large urban public teaching hospital with nearly 130,000 emergency department visits annually. Two datasets were generated from the DR. Dataset 1 – consecutive adult ED patients hospitalized with PE or DVT between July 1, 2007 and June 30, 2008. This was the “index visit”. Additional data extracted included demographics, chief complaints, past medical history, laboratory and radiologic orders and test results, diagnoses for the index visit and all other ED visits in the past year prior to the index visit. Dataset 2 – urine protein and blood albumin levels obtained from all other adult ED patients over the same time frame. Because our ED sees many repeat visitors, Dataset 2 used unique patients, not visits. The specific research questions were: 1. Did patients diagnosed with TE have a higher prevalence of proteinuria, low blood albumin or both than other ED patients? 2. Based on past performance, is there a need for decision support functions that aggregate ED patient risk factors as new clinical research becomes available?

Algorithms were written using SAS® (version 9.2, SAS Institute, Inc., Cary, NC) to extract data from the DR. For TE cases and all other ED patients (controls) all past urinalysis protein results were classified as zero protein, any proteinuria or significant proteinuria (≥ 300 mg/dl). The cut-off used for low albumin used was 3.7 g/dl. For TE patients, one year of prior visits were also examined for chief complaints or diagnoses consistent with possible TE. Comparisons of the proportions of TE versus control patients with test abnormalities were made using the z-statistic – finding no overlap in their 95% or 99% confidence intervals.

RESULTS

Among 214 TE patients identified, 147 (68.7%) had DVT and 67 (31.3%) had PE. Over the prior year, 96 (45%) of TE patients had a total of 261 past visits. Among those, 38 (17.8%) had chief complaints consistent with possible TE: leg swelling, chest pain or dyspnea, but had not received further testing for TE (d-dimer, ultrasound or CT scan). In addition, over the prior year, compared to control patients, TE patients had a higher prevalence of laboratory tests consistent with mild renal dysfunction and protein loss. Low albumin was demonstrated in 46 (21.5%) of TE patients versus 3,554/52,558 (6.8%) of control patients; (p < 0.01). Significant proteinuria was documented in 10 (4.7%) of TE patients versus 623 (1.2%) of controls (p < 0.05). Either mild to significant proteinuria or low albumin were found in 108 (50.5%) of TE patients compared to 3,348 (6.4%) of controls. If we limited the controls to only those who received both tests during the index year, 3,346/11,337 (29.5%) this difference was still significant (p < 0.05). Finally, among the 10 hospitalized TE patients with very high levels of proteinuria, only 2 (20%) received additional 24-hour urine protein testing.

CONCLUSIONS

We used our DR to examine an opportunity for incorporating new research findings into daily clinical practice. We found that compared to control patients, those diagnosed with TE had higher rates of past laboratory tests consistent with microalbuminuria. Additional significant results were that 17.8% of patients with TE had prior visits in the past year consistent with that same diagnosis. If we count only those with any prior visit, 38/96 (39.6%) had recent ED visits with similar TE symptoms but no diagnostic testing. Additional opportunities for education were suggested by the low rate of patients who received 24-hour urine protein testing for nephrotic syndrome when their random urinalysis suggested the potential for this diagnosis. The clinical data distribution and summary for individual patients would not have been readily available for clinicians at any single clinical visit; the DR made the aggregation of clinical risk data possible.
This pilot is a first step in our plan to evaluate the use of local decision support algorithms. Retrospective studies using the existing DR can evaluate opportunities for improved clinical recognition and management of frequently seen problems and the potential impact on patient outcome. In the future, we will use the DR to detect and flag important clinical associations in real-time that are not otherwise available to clinicians in the treatment setting. The highest priority targets for implementation are:

1. Clinical problems frequently encountered locally
2. Potential for significant impact on patient survival or quality of life
3. Demonstrated shortfalls in recognition, diagnosis or management in the clinical setting

Our approach was developed to address the usual problems with decision support flags: they may significantly slow down information system operations and clinicians develop a habit of ignoring them as they become more frequent. Ideally, we foresee using local DR to retrospectively determine the highest priority targets for updated educational programs linked to real-time decision support for individual institutions. We argue that local empiric studies demonstrating the importance of the clinical problems addressed will enhance clinician buy-in and improve care.

REFERENCES